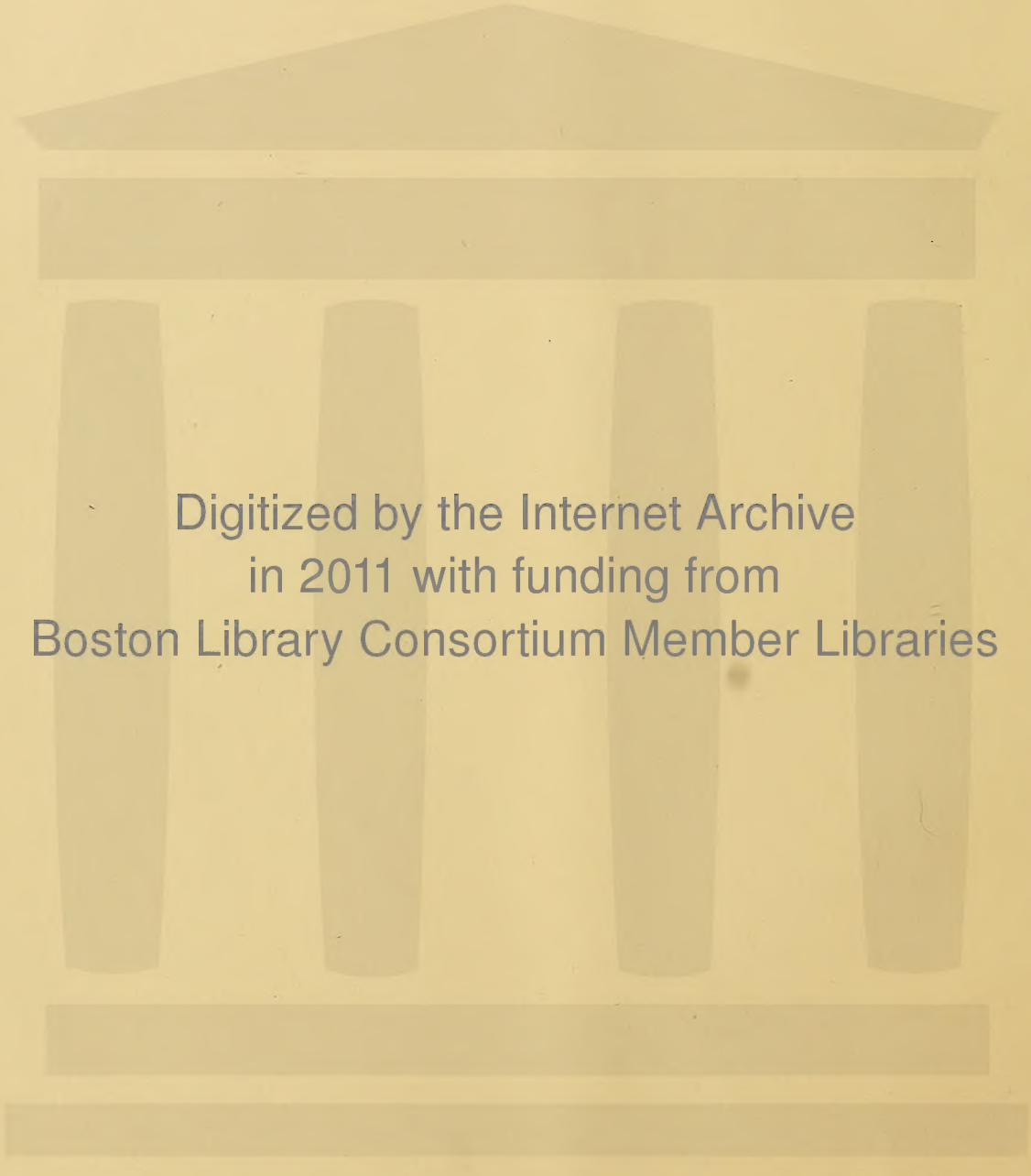

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A Private Electrical Laboratory.

It is not always in the commercial workshop that the most interesting and valuable experiments are made, and this is particularly true in the study of applied electricity, for it is possible with a comparatively modest outlay of money to procure many of the appliances which are in daily operation in many branches of the industry as well as many instruments for experimental research. There are few modern private residences in which electricity does not play some part in general utility work, and in many of the homes of men directly interested in electrical development are plants which are surprising for their completeness, and from which many new ideas are evolved and presented to the world. The private laboratory of a practical electrical engineer is of interest because there, in material form, are those ideas and subjects which are of prime importance to his mind and usually the man's favorite branches of the science may be recognized by a glance at his apparatus.

Such a laboratory is illustrated in this article and is the property of B. J. Arnold, of Chicago, who, although still a young man, has already made a wide reputation as an electrical railway engineer, as evinced by his work in designing the Intramural plant at the World's Fair and his connection with the proposed elevated electric road on the North Side. Mr. Arnold has utilized his residence for much of his experimental work, and he intends to make a number of exhaustive tests relative to the economic operation of lighting and power apparatus. The plant is noteworthy because of the facilities it gives its owner in all parts of the house to deduce results from operations which are at all times under his eye.

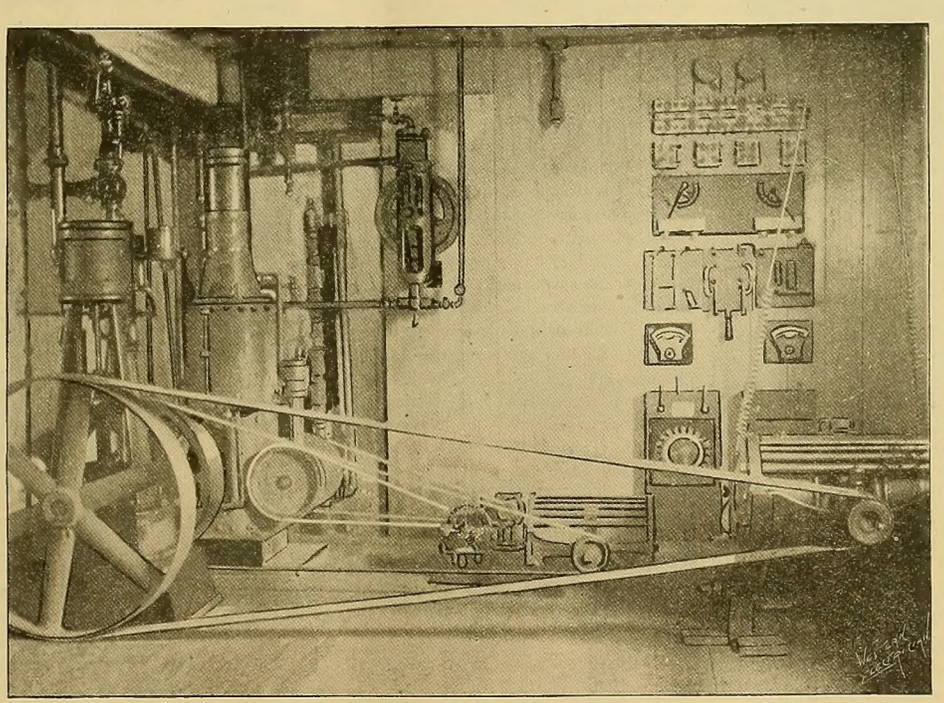


FIG. 1. A PRIVATE ELECTRICAL LABORATORY.

The first intention of Mr. Arnold was to install a set of storage batteries in the house in connection with the laboratory to be used in experimenting in certain directions for developing inventions which he had in mind. After having the storage batteries installed it became evident to him that he could light the house from the cells and heat the house from the boiler, thus utilizing the investment and effect a saving in monthly expense. The result was that the house was wired for electric lights throughout and fan motors placed in the various rooms. In the library arrangements for a phonograph are made, so that dictation can be given to the phonograph any time during an evening's study, and the contents of the cylinder transcribed by the office stenographer at pleasure, thus enabling one to jot down memoranda or write on any particular subject with much less time and labor than is ordinarily required.

The plant is arranged in accordance with the drawing presented in Fig. 5. In the rear of the house are located the coal bins, directly in front of the boiler, which is an eight horse power horizontal tubular boiler, set in brick, with the fire underneath it, the heat passing back through the flues and over the top of the boiler to the stack. The breeching is lead directly into an ordinary house chimney, having two openings each seven inches square, making a total area of 98 square inches, and having a height of about 25 feet. Ample draft is thus obtained for complete combustion. By the side of the boiler is located the cell room, shown in Fig. 3, in which are placed fifty-six 150 ampere hour storage batteries. These cells are about five years old and were originally used for train lighting on the Atchison, Topeka & Santa Fe railroad, but were abandoned on account of the excessive cost of maintenance. They were purchased and repaired by Mr. Arnold and have been doing good service for the last eighteen months, without any cost for repairs except to fill up occasionally with electrolyte.

As shown in Fig. 1, there is a six horse power vertical engine connected with the boiler which drives a four kilowatt 150 volt generator. Between this machine and the boiler is located a one horse power combined engine and boiler, a view of which is presented in Fig. 2, which was built for experimental purposes and is used for turning the small machines for performing experiments, when it is undesirable to increase the steam pressure on the large boiler high enough to run the large engine. In the engine or electrical room proper is located a turning lathe and a planer and other small tools, with the necessary work-benches, tool racks, etc. A view of the work-bench and lathe is shown in Fig. 4. Leading off from the electrical room is the chemical laboratory with the necessary cupboards and experimental tables for investigating the chemical side of electricity. Considerable work has been carried on by Mr. Arnold in this line, examining into the principle of storage batteries and testing the different cells now on the market.

It should be borne in mind that the entire plant was put in by the owner for purely experimental purposes, but it became evident to him that something practical could be made from it and money saved in operating. For this reason the entire house was equipped for steam heating. The boiler supplies the steam for heating the house during the winter months, and once in seven or ten days, depending upon the quantity of light used, the boiler is fired heavily so as to give higher pressure of steam than is used for steam heating and the engine run for about four hours to charge the cells. While the charging is being done the house is heated by the exhaust steam from the engine.

The furnace is so arranged that nothing but bituminous slack coal is burned under it, the coal costing $1.40 per ton, delivered in the bin in front of the boiler. About five tons per month of this coal is used under this boiler, which supplies the heat and light for the entire house, this making the combined cost of heating and lighting less then two-thirds the cost of heating by hard coal in the ordinary manner and lighting by gas. This is the practical result which the owner worked out after having the plant installed, but it should be stated that the plant was put in to fit existing conditions, and it is probable that many improvements could be made in a house built with the idea of containing such a plant, although it would be difficult to reduce the operating expenses.

The laboratory is equipped with a number of electrical and mechanical instruments for measuring energy and temperatures, and a record of results is kept for the owner's information. Adjoining the chemical room is a dark room for developing photographic negatives. The laboratory is supplied with a complete photographic outfit, and interesting experiments are often recorded by means of the camera.

Upon the switchboard, shown at the right in Fig. 1, are the following instruments: One Weston ammeter, one Weston voltmeter, two current indicators, two rheostats, six fuse blocks, two small switches, one four-point switch for throwing the cells on to the dynamo or lamps, one series-multiple switch for throwing the cells in series or multiple, and one automatic cut-out for breaking the charging circuit in case the voltage of the dynamo falls below the voltage of the cells. When the plant was first installed the cells were charged in multiple and discharged in series and worked fairly well, but it was found advisable to substitute a higher voltage dynamo and charge as well as discharge in series, for by so doing all trouble caused by the inserting and adjusting of resistance in the two sets of cell circuits has been eliminated, and all the cells are charged and discharged evenly. The cells are also connected with heavy conductors, so that they can be thrown in muliple for producing any voltage having a multiple of four, for the purpose of getting heavy currents at a low voltage for experimenting.

Fig. 6 shows the method by which the cells are connected with the switchboard for charging in multiple from a 75 volt dynamo and discharging in series to operate 110 volts lamps. The connections will be readily understood when the multiple series switch shown in the lower left-hand corner of Fig 6 is described. When the dynamo is charging the cells the double-pole double-throw switch is thrown so that connections are made from F to G and I to J. When the cells are discharging in series this switch is thrown so that connections are made from G to H and J to K, and the connections from F to G and I to J are opened. When charging in multiple a connection is made from A to C and another from B to D on the multiple series switch, by means of two brass bars fastened together with a fiber lever so that both can be thrown at the same time. If the cells are to be charged in series these bars are thrown so that a connection is made from point B to point E on the switch and the bar which formerly made a connection from A to C stands with its lower end midway between points C and D, making no connection. A permanent connection is made on the back of the switch from A to E. If the circuits are now traced it will be found that the cells are discharging in series. The circuit-breaker shown on the board consists of a soft iron armature attracted by an electro-magnet and as long as the voltage of the dynamo exceeds the voltage of the cells, this armature is attracted by the pole of the magnet and completes the circuit through an auxiliary contact, but as soon as the

dynamo voltage drops below that of the cells, the current starts to flow from the cells, causing the armature to drop, thus opening the circuit and preventing the cells driving the dynamo as a motor. It will be noticed that the rheostats are placed in such relationship with the cells that they are used both for equalizing resistance between two sets of cells when charging, and for controlling the electromotive force of the house lines when discharging in series.

It is the intention soon to install a gas engine by the side of the steam engine and conduct a series of tests of running the dynamo by means of the gas engine and steam

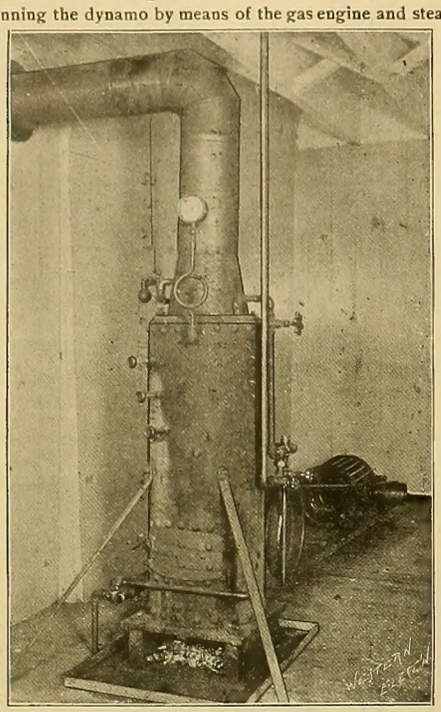


FIG. 2. A PRIVATE ELECTRICAL LABORATORY.

engine and ascertain which is the cheaper for driving lights. The inconvenience of handling the coal will be eliminated by use of the gas engine, and it is thought that the practical solution of the problem will be that the gas engine will be used during the summer and the steam engine during the winter, thus avoiding firing the boiler during the hot weather. It should also be borne in mind that the investment in this plant is of course much larger than it would be were the plant installed merely for heating and lighting, as it is equipped with numerous devices for experimental work, which would be unnecessary in a plant installed only for practical work.

Chicago's Police Patrol System.

The history of the police patrol system of Chicago is a record of rapid and steadfast growth and development, and perhaps in no other branch of the city government can such a praiseworthy advancement be recorded; and there is hardly a more important branch of municipal control

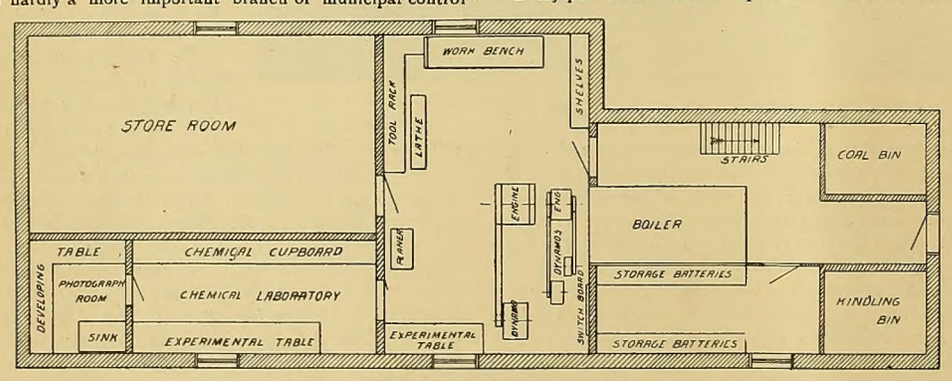


FIG. 5. A PRIVATE ELECTRICAL LABORATORY.

than that department which serves as an adjunct to the police department and renders it possible for such a large force of men to be kept under constant jurisdiction, from a central point, and for a policeman in any quarter of the city to communicate with his superior or the police office. The police patrol boxes, which are so familiar at the present time that they attract no attention, are of a comparatively recent date, and it is the rapid extension of the system in Chicago which makes it well nigh impossible for disturbances of a serious character to gain much headway in the city, and doubtless many destructive conflagrations have been averted by the same means.

Chicago is the pioneer in the introduction of this system, and here it may be said to have reached its present state of perfection. It was tn 1880 that John P. Barrett, superintendent of the fire alarm telegraph system, evolved the idea of controlling policemen in this way from a central station or sub-stations. Prof. Barrett's plan included the erection of octagonal boxes, eight feet high and two feet eight inches in diameter, placed at convenient street crossings and connected with the district station by telephone. During the first year thirty boxes were provided in the central district of the city, and a one-horse patrol wagon was detailed at the station to answer calls from the boxes. The area covered by the system at this time was about one and a half square miles. Its success was assured from the first day it was put in operation. Not only was the police department pleased with the results, but the general public saw in it the solution of many difficulties in municipal government, and the doing away with many unpleasant and serious occurrences.

Many changes and improvements in the appliances which form parts of the system have been made since its adoption, but the general scheme remains the same. There are now about 700 boxes in general use, and 30 two-horse patrol wagons are constantly on duty at the stations. The apparatus which connects the boxes and stations is principally automatic. Each police district has its own circuit of wires connecting all the boxes within its limits. The sub-stations are connected with the central station in the city hall by another circuit. At the central stations and sub-stations are the necessary instruments and batteries for receiving and recording automatically the signals received from the boxes.

The boxes are neat and compact so as not to interfere with street traffic. Policemen are provided with keys and the same privilege is extended to all citizens who apply for them and who are known to be trustworthy. However, the citizens' keys differ from those carried by the policeman from the fact that when inserted in the keyhole they cannot be withdrawn until they are released by the key carried by the policeman. By this ingenious contrivance the citizen who makes use of the box is obliged to lose his key or to remain until the arrival of a patrol wagon so that he can explain the reason for the call. Every key is numbered, and a register is kept showing to whom keys have been issued.

Inside the patrol boxes is the aparatus for communication with the station, which is contained within a small box. Inside of the small box, which for convenience may be called the alarm box, is a lever, a dial with six coils marked on it, an indicator which may be set to any one of them, and the transmitter and receiver of a telephone. There is also a small button bearing on its face the letters "O. K.," which indicates when any signal made from the box is received at the police station. When the policeman enters the box he opens the door of the alarm box, sets the indicator at any one of the six calls and pulls down the lever. When the "O. K." button springs into view, he can be sure that his signal has been received at the station. The six calls are for the patrol wagon to announce that the telephone is to be used, the capture of thieves, a riot, the test of telephone wire, and a call for the fire department.

Every policeman makes a report from the same box on his beat every half hour during his watch. By this means the location of every man on duty is known at the police station every 30 minutes, and his progress along his beat marked with absolute precision. He cannot evade the watchfulness of the operator at the station. He must report at specified places at certain times. He cannot send in a report from one box with the statement that he is reporting from another box, which might be a half mile away, because when he pulls down the lever the number of the box is automatically registered at the police station.

When the policeman makes his half-hourly report he turns the indicator to the telephone call. As soon as the "O. K." button shows him that his signal has been received at the station, he sends in his name and the report of any disturbance or unusual occurrence on his beat through the telephone. The difficulties in the way of his procuring some obliging friend to report for him are self-evident.

At the sub-stations the mechanical devices are simple. The operator sits behind a table resembling a common office desk. On the right hand is the telephone. On the left is the automatic register on which the signals from the boxes are recorded. In front of him is a key for signaling the fire department when necessary.

The patrol wagons are of the familiar type, with side seats and steps from the rear. Under the seats are compartments for handcuffs, clubs, rifles, blankets, canvas stretchers, ropes, a medicine chest and other necessary and convenient articles. Some idea of the increase of the work done in the last ten years by the patrol system may be gained by the following table:

	1882.	1892.
Reports received from the policemen in the district	362,311	4,689 860
Alarms responded to	14,724	61,497
Arrests made	7,482	39,981
Fires attended	672	3,210
Sick and injured persons taken to hospital	769	2,000
Sick and injured persons taken home	751	2,538
Sick and injured persons taken to station and cared for	241	803
Dead bodies taken to morgue	232	813
Dead bodies taken to residences	84	191
Disturbances suppressed without arrests	1,804	2,628
Insane persons cared for	193	755
Destitute persons cared for	236	786
Prisoners taken to county jail	580	5,401
Prisoners taken to Division Court	3,148	18,890
Packages stolen, property recovered	218	515
Miles traveled	No record	190,242
Lost children taken to parents	163	1,504
Mad or crippled animals killed	24	111
Stolen horses recovered	16	82
Stolen vehicles recovered	21	78
Abandoned children taken to Foundling Home	89	63
Persons rescued from drowning	10	18
Inebriates taken to charitable institutions	32	968
Runaway horses overtaken and stopped	.	74
Miscellaneous	30	11,75*

Each signal box was used during 1892 an average of 6,787 times.

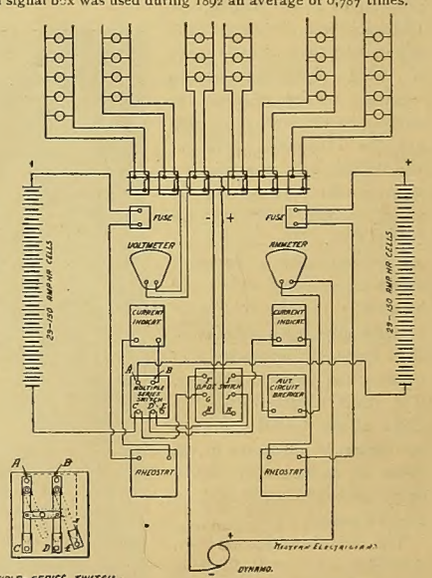


FIG. 6. A PRIVATE ELECTRICAL LABORATORY.

The city owns its electric plants and has a manufactory where most of the appliances used in the police, fire and electric lighting departments are made at much less cost than they could be purchased. As rapidly as possible all the wires in use in the patrol, telephone and fire systems are being placed underground. At the present time the city has nineteen miles of underground conduits, iron pipes and wooden boxes, in which 570 miles of wire is placed. There are 1,840 miles of overhead wires, so that not quite one-quarter of the wires are underground.

Nearly all of the apparatus in use in the patrol telephone and fire alarm service has been invented by Prof. Barrett. He has turned the patents on these inventions over to a private company, but the city has reserved the right to manufacture for its own use any of his inventions in this connection. The police patrol telephone system has cost the city $150,000 to $200,000, but the saving it has effected has probably been much greater. The one item of transportation of prisoners, dead or injured people, and other unfortunates, who had to be carried from one place to another annually, amounts to a very respectable share of the total cost of the system. Over 35,000 people were sent distances varying from a few blocks to ten miles in patrol wagons during 1892. If the average cost of transporting them by other means is fixed at 50 cents, this one item saves the city $15,000 annually. But the greatest benefit derived from the system is in the control which the chief of police has over the men under him The efficiency of the force is certainly doubled, and at critical times, as when a riot is imminent, it is quadrupled. So successful has the patrol telephone system been in this city that it has been copied in nearly every large city in the country except New York.

Trouble at Deptford.

American electrical engineers who have followed with interest the development of the remarkable installation at Deptford, in England, which has made the name of Ferranti famous, will regret that fresh difficulties have arisen. The following account is taken from the London *Electrician* of December 15th:

The supply of electrical energy from Deptford was last week once more impeded by a series of accidents. Unlike the recent difficulty at Bankside, where the failure of the field circuit of one machine spread trouble through the remainder of the plant, the three mishaps at Deptford were practically independent. Unlike the Bankside acci-

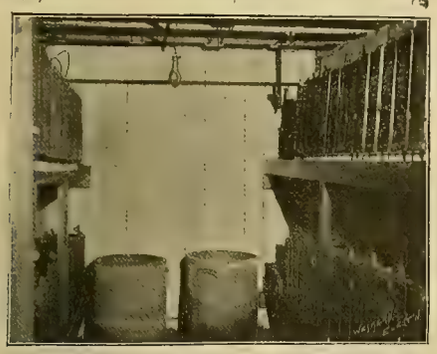


FIG. 3. A PRIVATE ELECTRICAL LABORATORY.

dent, too, they did not arise from electrical causes, but were purely mechanical. And to push the contrast further, the Mordey alternators suffered from being banked together before suitable cut-outs had been fitted, the subdivision of units rendering no assistance, while the Ferranti plant failed to maintain the supply on account of the large size of the units and the consequent fewness of machines.

The chronicle of last week's misfortunes is as follows: One of the two large dynamos, which used to be called 1,250 horse power, but which have proved to be nearer 1,750 horse power, was under repair; new armature coils for generating at 2,400 volts instead of 10,000 volts were being fitted. The spindle of one of the Corliss valves on the other set was damaged, and the engine had to be shut down. Another dynamo of 750 horse power had been disabled during the week, something having fallen into the armature, wrecking the coils and bending the shaft. One of the 350 horse power engines used for light-load work was at the time undergoing repairs to the governor. To add to the week's misfortunes, which were serious only because of their concurrence, the throttle valve of one of the large engines broke, and fouled the main valve. On Monday, Thursday and Friday the supply was partially checked, and on Friday evening only two engines, one of 750 horse power and the other of 350 horse power, were running until 8 P. M., when the full supply was restored.

It will be remembered that the two 1,750 horse power sets, with armatures 12 feet six inches in diameter, occupy one quarter of the present engine house at Deptford, and about one-sixteenth of the whole space available for machinery. But thirty-two units of plant were never contemplated. One quarter of the present building was set apart for condensers for 120,000 horse power, and in the remaining half, four 10,000 horse power alternators, with 45 feet armatures, were to be put down. The incomplete condition of the station does not, however, affect the number of divisions of the plant, for several sets that were at one time running at the Grosvenor Gallery are now in use at Deptford. It has been argued that far larger marine engines run continuously for weeks, under confined conditions of space. But the working conditions are altogether

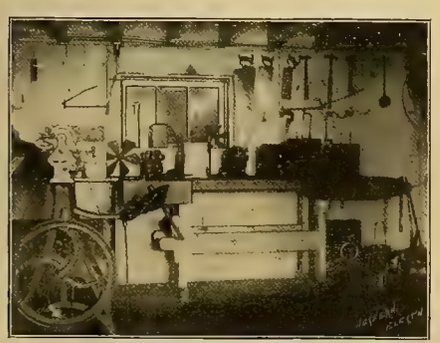


FIG. 4. A PRIVATE ELECTRICAL LABORATORY.

different, for the load at sea is comparatively constant, and the engine room is not manned with the object of saving a decimal of a penny per horse power hour, as in most electric supply stations. Had the load at Deptford been anything like that which might have been reasonably expected before the run of bad luck began, and had six or eight sets of 1,750 horse power alternators been employed, such misfortunes as these could not have happened. The London Electric Supply corporation has to do the best it can with its present plant, and our sympathies are with them and their engineering staff. But the accidents teach the danger of using large and few units of plant, and the importance, where alternators are used, of reserve machines, and of some efficient system of boxing in the armatures.

Searchlight in the War in Morocco.

The sketch from which was produced the accompanying engraving, illustrating the use of the electric searchlight in the war on the Riffians was secured under unusual circumstances. *L'Illustration*, a weekly Parisian newspaper, assigned one of its representatives to the task of securing news and sketches from the seat of war. The artist applied to the Spanish government for permission to visit Melilla, but while his request was not denied, he was put off from day to day by a courteous announcement that his application would soon be passed upon. He became discouraged and determined to go to Melilla on his own account. He joined temporarily, a Spanish ambulance corps and was able to secure sketches and photographs under the protection of the red cross. The Spanish authorities on the field came to the conclusion that it was unwise to maintain an artist of this kind in an ambulance corps, and he was formally sent home. The illustration represents the searchlight from projectors on the Spanish man-of-war Comte de Venadito disclosing the positions of the insurgents on the Morocco shore.

A Strange Allegation.

As an illustration of the intense feeling and easily excited suspicion aroused by the trial of "Dan" Coughlin for implication in the Cronin murder, now in progress in Chicago, the following extract from an article in a Chicago daily newspaper is of interest:

Several days ago it was hinted that the incandescent light just south of the jury box flashed in a mysterious way. It was noticed that the light would blaze and then die out. The regularity of the thing was remarked. Finally it was thought that it was a system of signals arranged to communicate with the jury. It is known that several men on the jury understand telegraphy and the matter was given some attention by the attorneys. A watch was set, but the flashing of the light has not been repeated.

While it is, of course, not impossible to arrange a system of signaling by incandescent light, still it is highly improbable that the lamp circuit could be tampered with sufficiently to afford an independent source of current supply without detection.

SEARCHLIGHT IN THE WAR IN MOROCCO.

Scenic Theaters.

In relation to a statement in the *Electrical Engineer* of London to the effect that the scenic theater in the electricity building at the World's Fair was installed by the Western Electric company under an arrangement with Siemens Bros., of London, an officer of the former company says: "The statement is incorrect in every respect. The apparatus used in producing lighting effects in our scenic theater at the World's Fair was of our own design and manufacture. We knew nothing about the Siemens model previous to their opening their exhibit on the Midway Plaisance, and have never negotiated with them for the right to use any of their apparatus anywhere."

A Peculiar Fan Motor.

A new type of fan motor has been recently patented by O. F. Conklin of Dayton, O., which embraces some interesting features in the disposition of the magne ic field and the armature. The arrangement is such, as will be seen from the accompanying cuts, that the field magnet and coils are placed compactly within the armature, and the armature is placed in segmental channels in the pole pieces. By carrying the pole pieces up over and down around the armature, the cross-section of the air space is materially increased where the armature is exposed to the action of the field; the result is gained of a reduction in the magnetizing force necessary to operate the motor.

In the drawings Fig. 1 is a plan view of the motor while Fig. 2 is a vertical section. Referring to the two in conjunction, A and A' indicate the pole pieces, each of which is provided with segmental channels $a\,a'$ of a depth and width slightly greater than that of the armature $B\,B$ and in which the latter is inclosed and adapted to freely revolve. The armature is thus completely incased in the pole pieces. B' is a revolving supporting plate provided with a series of lugs $b\,b$ projecting from its inner

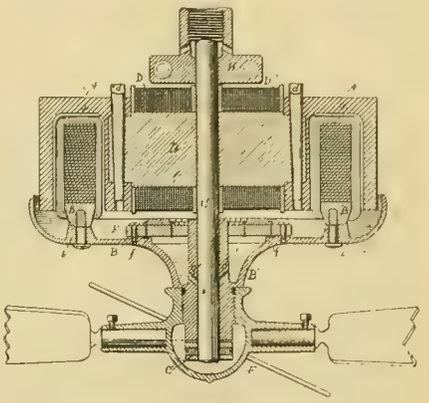


FIG. 2. A PECULIAR FAN MOTOR.

surface through which screws are driven to secure the armature to the plate. This plate is also constructed with a hub B'' in which bearing is furnished for the supporting shaft C, and a hollow portion forming a lubricating chamber c from which oil is fed to the shaft through channel $c'\,c'$. C' indicates a collar fixed to the lower end of the shaft C and upon which the plate B' is supported by the hub portion B'' bearing on said collar. D is the field magnet core, the ends of which project into cored-out parts of the pole pieces to such an extent that the pole pieces overlap and entirely inclose the ends of the core. Vertical pins $d\,d$ penetrate the overlapping parts of the pole pieces and the ends of the field magnet core to secure these parts together. The field magnet is also made rigid to the shaft C by means of a screw being driven through the core into a recess in said shaft. $D'\,D''$ represent the field magnet coils, which are comparatively small. The commutator plate E is attached to the bottom of plate B' by screws passing through a series of lugs; it rests upon an annular rib or ring f on the inner surface of the plate and forms the upper inclosure of the oil chamber c. The commutator brushes are supported in holders $h\,h'$ in

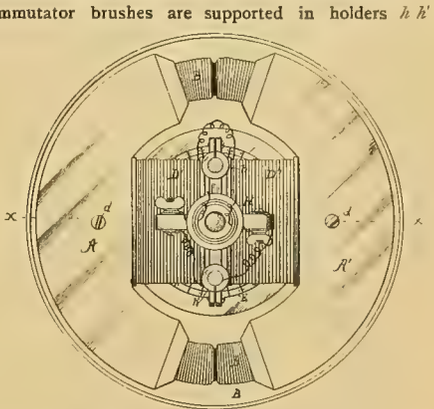


FIG. 1. A PECULIAR FAN MOTOR.

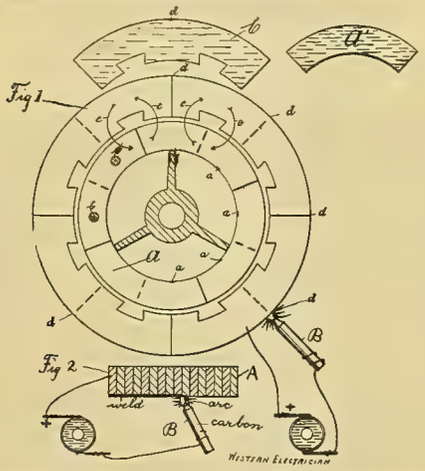
sockets in laterally projecting arms carried by the coupling piece H. The stationary shaft C is coupled to this piece as is also the hollow shaft or pipe that depends from the ceiling. F indicates a combined oil cup and support for the fan blades that incloses the lower portion of the shaft bearing by a screw threaded engagement with the hub B'' of the supporting plate.

Improved Method of Making Magnetic Cores for Dynamos and Motors.

By Albert W. Smith.

The object of these improvements is to obtain a more rigid and cheaper construction than is possible when bolts and end clamping rings are used, and also to prevent the inevitable losses from foucault or waste currents incidental to the use of bolts and solid end clamping rings.

The armature core *A* is built of sheet iron segments *A'* in a suitable former or frame, so that the joints between segments of successive layers alternate or break joint with one another as shown; the whole mass is then strongly compressed and temporarily held in this condition by suitable clamps and bolts. The core *A* is now connected with the positive wire from a suitable source of electrical energy, and the carbon *B*, which may be mounted on a suitable slide, is connected with the negative wire as shown. The arc is then formed as indicated between the core *A*, and carbon *B* as shown in Fig. 2, and the segments are welded together at their inner edges from end to end of the core. The depth of the welds can be varied by varying the current strength, and may be from one-sixteenth to one-quarter of an inch, as desired. The welding does not burn out the insulation, as the heat is local, and the welding is instantaneous. The welds can be made at intervals as at *a a a*, or the entire surface can be welded over if desired. By this process a core is obtained having practically the same strength to resist centrifugal force as a solid piece of iron, yet being perfectly insulated and laminated, for its strength will be that due to the welds



IMPROVED METHOD OF MAKING MAGNETIC CORES FOR DYNAMOS AND MOTORS.

themselves and the friction between the segments, due to the pressure between the segments, which is retained by the welds *a a a*. The welds being on the inside surface do not cut any lines of force, and hence there can be no loss from eddy currents, as is the case when bolts *b b* and solid end rings are used. The core can also be mounted on a much simpler spider than is possible with ordinary cores, as it can be pressed onto a three-armed spider of cheap and simple form.

This process is also adapted for making field magnet rings for multipolar dynamos and motors. These are built up of segments *C*, Fig. 1, so that the joints occur at the center line of pole pieces as shown and are then welded at the points *d d d*. The advantages of a sheet iron field are obvious, being forty per cent. lighter than cast iron, while for multiphase and other alternating current motors a laminated field is essential. As the points *d d d* are not cut by any lines of force (see arrows *e e e e*) no eddy or waste currents are induced at welds formed at these points.

To make field magnets for large continuous current generators the U-magnets *D D D*, Fig. 3, are built up of sheet iron punchings and welded at points *c c c c*. Magnets made in this way can be drilled and tapped like a solid piece of iron; they can therefore be bolted to a light sectional framing *E*, Figs. 3 and 4, which compares advantageously with the heavy and more expensive side clamping frames employed in present practice when laminated fields are used. In making cores by this process there is very little iron wasted; they can therefore be made cheaper than is now possible. The cores will also be more efficient in operation, as there are no paths for waste or eddy currents.

Hugh Burns has purchased the electric light plant at Taylor, Tex., for $8,500. Mr. Burns will continue the operation of the plant.

The common council of Romeo, Mich., is instructed to grant a franchise for the lighting of the village to the International Electric company of Detroit.

Central Station at Bockenheim, Germany.

In the central station of Bockenheim, Germany, both continuous and polyphase current apparatus are used, and the distribution is effected on rather unusual lines. The station is divided by a wall into two large departments, one of which is the engine room, the other containing the boilers, the office, accumulator room and the store room.

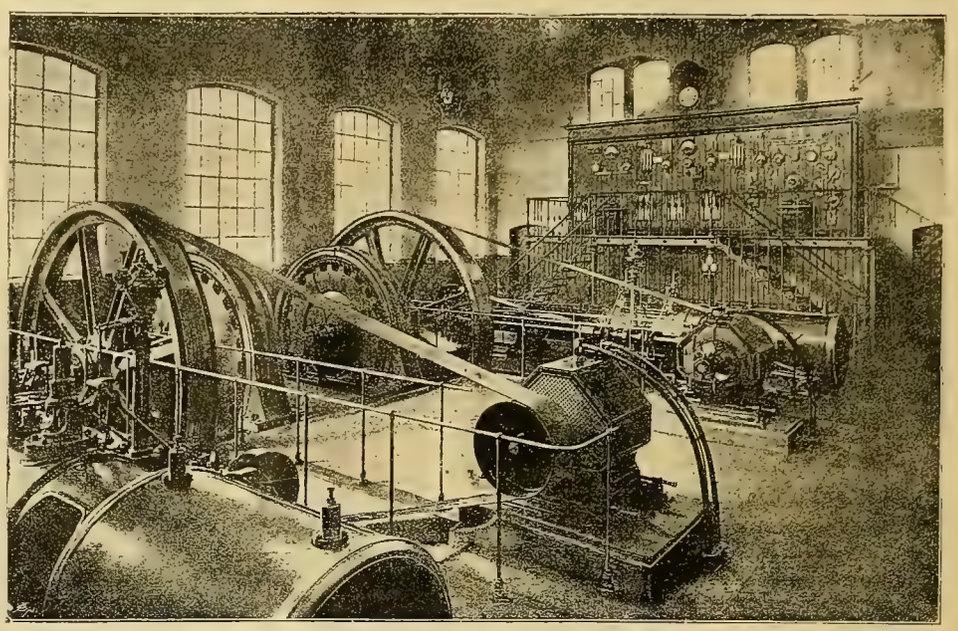
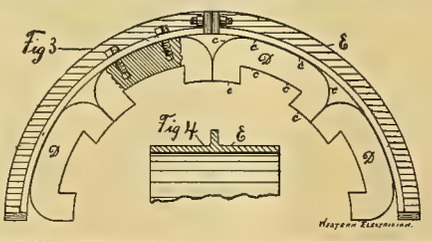


FIG. 1. CENTRAL STATION AT BOCKENHEIM, GERMANY.

The two boilers are tubular, and have a heating surface of 1,165 square feet; steam is generated at a pressure of 150 pounds. The two engines are compound condensing and have a capacity of 250 horse power each. Each engine is coupled directly to a 130 kilowatt 80 volt triphase machine, and drives by a belt a continuous current 110 volt dynamo of a capacity of 36.8 kilowatts. The electrical apparatus was manufactured by W. Lahmeyer & Co., of Frankfort-on-the-Main. Fig. 1 gives a general view of the dynamo and engine room.

The distribution is effected by means of both direct and triphase currents. Fig. 2 gives a diagram of the system. At the lower part of the diagram are represented the two continuous current machines *A* and *B* connected in multiple. These dynamos can supply the external circuit and at the same time charge a battery of accumulators *C*. If it is desired, these machines can be employed only for charging the accumulators. A part of the continuous current traverses the field circuits *D* and *E* of the triphase machines *F* and *G*. From each of these generators three



IMPROVED METHOD OF MAKING MAGNETIC CORES FOR DYNAMOS AND MOTORS.

wires lead to the circuit breakers *cc* and the ammeters A_m, and are connected to the low tension distributing bars *J*. The difference of potential between two wires is 80 volts. The phase indicators *I*, consisting of incandescent lamps in series of two, make it possible to effect the maneuvers necessary for coupling the dynamos in multiple. From the distributing bars the current is conducted by the switches *K* and *L* to the primary circuits of the transformers *M* and *N*, by which the potential is raised from 80 to 700 volts. The secondary circuits of the transformers are connected with distributing bars leading to the feeders. The potential of the bars is read by the voltmeters *V* and *V*.

The accumulators installed in the station are the Tudor type, and were made by the Hagen accumulator works. Their capacity is 430 ampere-hours; the charging current is 110 amperes, and the maximum discharging current is 143 amperes. The current is carried in lead-armored cables laid in the ground; the cables used for the triphase current are concentric. In the suburbs and in the manufacturing district the conductors are above ground and are bare wire.

At a sub-station three quarters of a mile from the power plant are installed two transformers of a capacity of 25 kilowatts each. One is in continuous operation, and the other is held in reserve. The transformers are motor-dynamos, the motors being designed for triphase currents and the dynamos delivering current at low potential.

Fifteen triphase motors are in use, varying in capacity from 3 to 15 kilowatts, in places where power is required, including foundries, press rooms, furniture manufactories, machine shops, etc. Fig. 3 gives a view of a shop in which screws are made. The use of a steam engine has been discarded, and the entire power is furnished by a triphase motor. The machines are found to operate in an exceedingly satisfactory manner. The foregoing description is summarized from an article in the *Elektrotechnische Zeitschrift*.

Rewards for Meritorious Discoveries and Inventions.

Attention is directed to the fact that the Franklin Institute of the state of Pennsylvania for the promotion of the

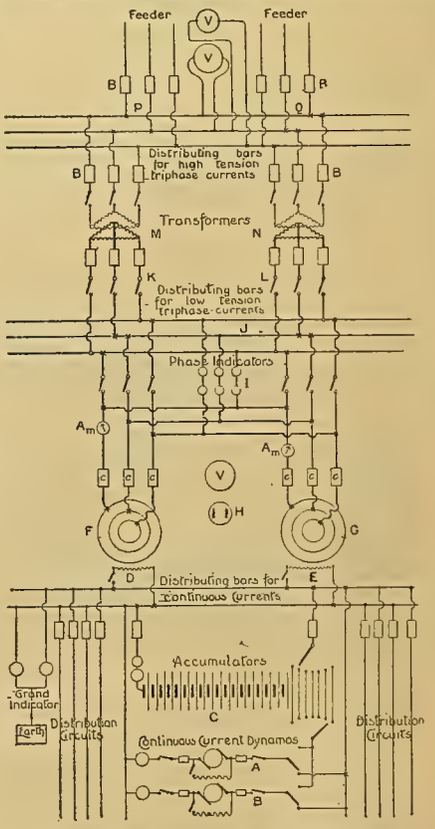


FIG. 2. CENTRAL STATION AT BOCKENHEIM, GERMANY.

mechanic arts may grant, or recommend the grant of, three medals for meritorious discoveries and inventions which contribute to the promotion of the arts and manufactures. The Elliott Cresson medal was established in 1848 by the gift of the late Elliott Cresson. This medal is of gold,

and by the terms of the deed of trust may be granted for some discovery in the arts and sciences, or for the invention or improvement of some useful machine, or for some new process or combination of materials in manufactures, or for ingenuity, skill or perfection in workmanship. The John Scott legacy premium and medal ($20 and a medal of bronze) are awarded by the city of Philadelphia. This medal was founded in 1816 by John Scott, a merchant of Edinburg, Scotland, who bequeathed to the city of Philadelphia a considerable sum of money, the interest of which should be devoted to rewarding ingenious men and women who make useful inventions. The premium is not to exceed $20, and the medal is to be of copper, and inscribed "To the most deserving." The control of the Scott legacy premium and medal is vested in the board of directors of city trusts, and has been referred by the board to its committee on minor trusts, and that committee has resolved that it will receive favorably the name of any person whom the Franklin Institute may from time to time report as worthy to receive the premium and medal. The Edward Longstreth medal of merit was founded in 1889 by Edward Longstreth, machinist, and late member of the Baldwin Locomitive Works. This medal is of silver, and may be awarded for useful invention, important discovery and meritorious work in, or contributions to, science or the industrial arts. Full directions as to the manner and form in which applications for the investigation of inventions and discoveries should properly be made will be sent to those interested on application to William H. Wahl, secretary, Franklin Institute, Philadelphia, Pa.

An Australian Electric Railway.

In all the colonies of Australia there are but two electric railways in operation, and but one of these—that located at Sydney—is Australian if the word be strictly employed, as the other, which is the one shown in the accompanying illustration, is found in Hobart, the capital of the outlying island of Tasmania, which is a city of some 30,000 inhabitants. Unlike the Sydney plant, which is almost entirely made up of American machinery, the Hobart line is equipped with a steam and electrical plant furnished by Siemens Bros., of London. The rolling stock was also furnished by the same company, although the contract was sub-let to the Lancaster Wagon company. As the illustration shows, the cars are double-decked, and they are designed for 24 inside and 24 outside passengers. They were built of teak, ash and mahogany, and are doubtless

AN AUSTRALIAN ELECTRIC RAILWAY.

strongly constructed, although lacking the elegance of appearance which characterizes American cars. The trolley arrangement also seems crude and clumsy when compared with the pole and rolling contact of the American system.

The operating company is the Hobart Electrical Tramway company, an English corporation, which has secured a perpetual lease of the necessary rights-of-way by purchase from a local syndicate. The line is of single track and is about ten miles long, the point selected for illustration being at the corner of Macquarie and Elizabeth streets. The steepest grade is on the Newtown line, where for about 350 yards there is a 6 per cent. rise. In other places there are some rather severe curves and grades. The rails are 40 pound Vignoles rails, with guard rails throughout, the joints being spanned by copper strap riveted to the rails. The trolley wire is supported from poles on either side of the street, galvanized steel wires being used for suspension. It has been found necessary in some places, in order to clear the telegraph and telephone wires, to cover the tops of the poles, which are mostly iron.

The power house and car shed are situated at the lower end of Macquarie street, near the Hobart river, and built on cement concrete set on piles. The power house consists of a galvanized iron shell with wrought iron girders and columns, with brick and wooden partition walls. It was designed in England, and sent out ready to erect. The chimney stack, 90 feet high and five feet in diameter, is of wrought iron, riveted throughout and stayed with stranded steel stays. There are four of Marshall's multitubular locomotive boilers, giving steam at 160 pounds pressure to three Willans central valve high speed compound engines running at 350 revolutions. Two No. 5 Worthington steam pumps pump the feed water through two Marshall's feed water heaters of 100 horse power each. There are three compound wound Siemens dynamos, giving 250 amperes each at 500 volts, coupled directly to the engines, on one bed-plate. The shaft of each carries a fly-wheel 4 feet 2 inches in diameter. Two Siemens 15 horse power motors are used for each car, geared to the car axles with single reduction spur gearing working in oil.

Much delay has been caused by the telephone people, who claim that the working of the railway seriously interferes with the efficiency of their system. As the telephone system of Tasmania is under government control, the railway company has thus far had rather the worst of the contention.

Convention of the Northwestern Electrical Association.

A convention of the Northwestern Electrical association will be held in Milwaukee, Wis., beginning January 17th, and lasting two days. A special effort has been made to make this meeting particularly interesting and a number of papers have been prepared which will doubtless be very instructive. The meetings will be held at the Hotel Pfister, commencing at 2 P. M. on Wednesday, and ample accommodations have been secured for the members. A number of social events will tend to bring the members into closer acquaintance, and every effort will be made to properly entertain the visitors. The papers to be read are: "New Things in Electricity," W. W. Low, Chicago; "Essential Station Instruments," Prof. D. C. Jackson, Madison; "Economical Use of Transformers," W. Forman Collins and P. J. McFadden, Chicago; "Corliss Compound Engines," E. L. Debell, Sheboygan; "Advantages of Direct Connection," W. N. Stewart, Chicago; "How Shall Members Buy Supplies?" H. C. Thom, Madison. The "Supply of Electrical Power from Central Stations" will also be discussed.

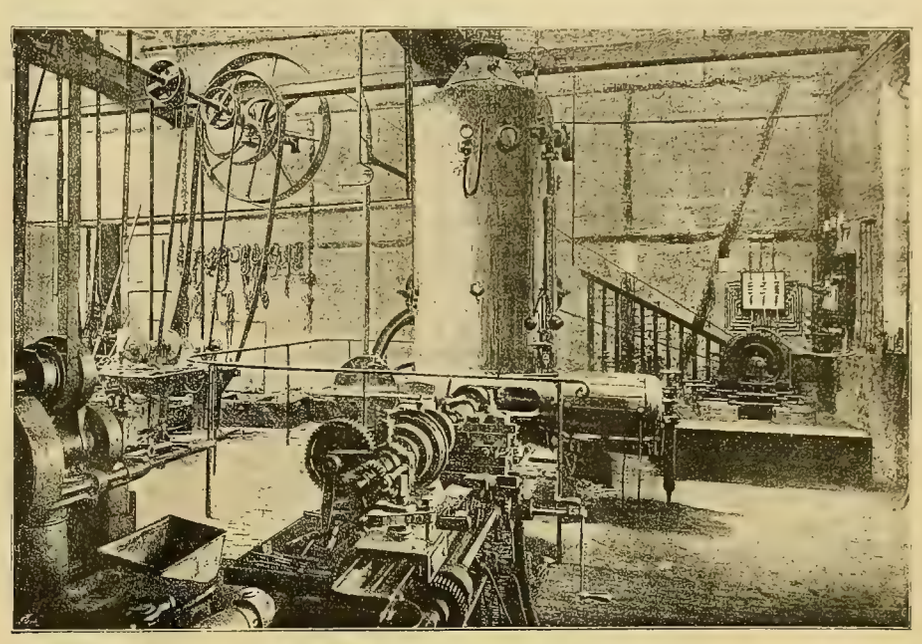


FIG. 3. CENTRAL STATION AT BOCKENHEIM, GERMANY.

Electrical Sanitation.

Many experiments are being made in different European countries with M. Hermite's system of electrical sanitation. In France the municipality of Brest is at present preparing a practical test of the purifying method, and preparations are also being made at Nice for a trial of the same system. The trial at Nice will take place in the English section and will be conducted upon a large scale. When the experiments at this place have been begun M. Hermite is to make a flying visit to Alexandria and Cairo, with the object of arranging for trials of his methods in these Egyptian cities. As for Paris, it is probable that the Ile de la Cité will be made the scene of experiments on a large scale. It is said that numerous Paris municipal councillors are in favor of a thorough trial such as would be offered by the Ile de la Cité, on which stands the great hospital of the Hotel Dieu. Municipal officers in other cities have written to M. Hermite with the object of making experiments with his electrical sanitation system, so that probably many other districts in France and abroad will before very long have an opportunity of seeing the operation of this system.

The Supreme Court of Georgia held, in the recent case of Willingham against Western Union Telegraph company that where a telegraphic message, delivered on Sunday for transmission, did not show on its face that it related to a subject matter which would render transmission and delivery a work of necessity or charity, and where there was no averment in the declaration either that the dispatch in question did relate to such a subject matter, or that the telegraph company, its agent or servant, was informed that it had relation to any such matter, the failure to transmit and deliver it on Sunday was not actionable.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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WE have tried advertising in several electrical papers, and after discontinuing our advertisement in your journal [*Electrical World*] we advertised for a considerable period in the WESTERN ELECTRICIAN, which we found a valuable paper for reaching the West, our card in that paper bringing us many communications, a number of which resulted in sales of our alternating apparatus, including a plant for the University of Wisconsin.—*Extract from a letter of F. A. La Roche, president of the La Roche Electric Works, Philadelphia, to W. J. Johnston, publisher of the Electrical World.*

JUST at present there is no branch of the electrical business which offers such an interesting situation as the telephone field. The Bell receiver patent will expire on the 30th day of this month, and this important event could hardly occur at a more propitious time to insure an immediate and wide extension of the telephone manufacturing business at the hands of independent companies. Owing to the general business depression there is much unemployed capital and many idle factories throughout the country, and it can hardly be doubted that many manufacturers will be eager to utilize their plants in the production of telephones, once the patent restriction is removed. This is a fact that is generally recognized by all cognizant of the state of the electrical business in this country, and there is a widely extended impression that we are on the eve of an era of the active production of cheap telephones and of a healthy competition.

When a telephone can be purchased as freely in the market as a telegraph instrument and at a reasonable price, an active demand will at once spring up for instruments for private line service. Extensive public institutions and business establishments will be fitted with local circuits to connect the various departments, and the telephone will also come into greater prominence as a social factor, as little coteries of friends in residence districts establish private lines for mutual entertainment. Hundreds, perhaps thousands, of villages where the telephone is now practically unknown for lack of sufficient support for a central station under the existing rates will be glad to avail themselves of cheap instruments sold outright. The market in sight is clearly of great extent, and it needs no prophet to predict that this business will be eagerly sought.

There are many who contend that the Bell company is so strongly intrenched by investment, prestige and the control of subsidiary patents that it will be impossible to operate a telephone system in competition with it; and the unexpired transmitter patents are undoubtedly of great value. But with the prize in view and the insurmountable receiver patent out of the way, it will be strange if the ingenuity of American manufacturers does not evade the obstacles that remain. There can be no doubt that this will be the case in relation to the private line business already referred to. The telephone situation in large cities will be more complicated, principally owing to the inconvenience to business men in being connected with two or more exchanges; but we have yet to be convinced that it will be impossible to establish successful competition to the Bell licensees in large cities.

Everyone who has the true welfare of the electrical industry at heart will cordially welcome the change in sight. Let there be a clear field and no favor in the telephone as in any other business. By its grasping, selfish methods the company owning the receiver patent has made itself unpopular with the American people, who will eagerly turn to others for relief. There should be independent manufacturing companies selling their products to distinct and separate central station and isolated users, as in the electric lighting industry. It would be a calamity if the Bell people should succeed in perpetuating their monopoly without patents, as the Western Union Telegraph company has practically done, but we have no fear that such will be the case.

MANY of the most important appliances utilized for the public safety and convenience have become so familiar in their everyday operation that they are no longer subjects of even passing curiosity. This is especially true of the police patrol system, which has been of very material assistance in meeting many of the social problems of the time, serving to check serious disturbances in portions of a city remote from its center and rendering possible the mobilization of the police force. An idea of the details and growth of this service may be gained by referring to an article in this issue of the WESTERN ELECTRICIAN upon the system as operated in Chicago, where indeed, the idea was first advanced and the service perfected. The subsequent adoption of its essential details by the majority of the important cities in this country is the best proof of the excellence of the scheme.

CONSIDERABLE space is devoted in this issue to the elaborate programme of the American Electro-therapeutic association, but the importance of the subject entitles the announcement to a wide publication. The society in question is composed of conscientious medical practitioners associated with competent electrical men, and embraces within its membership not a few who are qualified to consider this important subject in both of its scientific aspects. Broadly speaking, the association is organized to develop the application of electricity to the alleviation of the physical ills of mankind. How thoroughly it proposes to collect and digest facts for this purpose is shown by the plan published elsewhere. This object is a most worthy one, and the legitimate practice of electro-therapeutics is undoubtedly destined to occupy a position of constantly increasing prominence in the science of medicine. We hope that all who have had experience in this direction will heartily co-operate with the various committees of the association.

THE prospect of the erection of an elevated railroad in Chicago to be operated by the use of electrically transmitted power should be received with gratification by the general public as well as by the electrical fraternity. Experience with similar roads in Liverpool, England, and at the World's Fair shows that the public is quick to recognize the many obvious advantages of electrically operated cars on elevated structures. The annoyance of smoke and dirt from locomotives traversing thickly populated streetsis done away with, and the drawback of overhead trolley construction is also eliminated. The principal question presented by a consideration of the two systems is the relative economy of installation and operation, but it now appears to be demonstrated that by the use of cheaper fuel in the power house of the electrical system than is permissible under the boilers of steam locomotives for street service the use of electrically transmitted power is considerably cheaper. The ordinance for an elevated railroad on the North Side of Chicago, on which it is proposed to use electric motors, has passed the city council, and it is to be hoped that no obstacle will arise to prevent the consummation of the project.

IT IS reported from Hartford, Conn., that the street railway company has been granted the privilege of the trolley for its west side lines by the city government, under restrictions which are looked upon as so onerous that the company cannot accept with any hope of making the venture a paying one. The Main street lines, three in number, are excluded from the use of the trolley, and the inhabitants along that street are not specially well pleased with the grant, while those on the west side, who rather opposed the trolley, are as much disturbed the other way, and several citizens threaten an injunction against the use of the trolley, in case it should be introduced. "Thus the whole summer's discussion of the rapid-transit problem," writes a correspondent, "bids fair to amount to nothing, and the whole matter will go to the people in the April election, when the trolley, or some sort of rapid transit, will be the issue before partisan politics are considered at all. Hartford is now about the only one of the larger New England cities that still depends upon horses for street transit." It is strange that aldermen so often succeed in making a mess of proposed rapid transit franchises. But there can be little doubt that Hartford will go for electric traction next year.

A RETROSPECTIVE glance over the electrical field and electrical achievements during the last year reveals the fact that, despite the almost universal depression throughout the industrial world, the electrical trade has withstood the trial well, and that advancement has been made in many particulars. Charles G. Armstrong of Chicago, in preparing a paper reviewing last year's work, has touched upon most of the important points. He dwells upon the lessons taught by the electrical display at the World's Fair and the electrical congress, and refers to some of the valuable discoveries which have been recently made in the use of electricity applied to medicine. Alluding to the subject of storage batteries, he says that "a renewed interest is being taken all over the country in this line of work, and I believe that the year of 1894 will see some improvements that will be startling in this connection." One of the most important occurrences of the last year has been in the line of a better understanding between electrical engineers and insurance inspectors as to what constitutes a safer and better method of electrical construction, and an almost uniform adoption of permanent channels within buildings in order that the wires may be accessible for repairs and removal. Valuable improvements are being made in electrical heating and cooking apparatus. Altogether there is much to recall with satisfaction during the last twelve months, and there is no doubt that the present year will witness the introduction of much that is new and of value as well as a substantial revival of business.

North Side Elevated Road in Chicago.

On December 27th the Chicago council passed an ordinance which in some respects is one of the most important ever passed by that body, not only because that ordinance allows of the construction of an elevated road for the North Side, but because it has become apparent to those who have been carefully following the plans of the Northwestern Elevated Railroad company that the motive power to be used is electricity. Various statements in relation to the plans of the company have appeared from time to time, but heretofore definite information has been lacking. However, now that only the signature of Mayor Hopkins in confirmation of the ordinance is awaited before the company can proceed with its plans, some of the backers of the enterprise and their ideas have become better known. From one of the incorporators it is learned that the supposition of an electric equipment for the new road may be in all likelihood stated as a fact. That this decision on the part of the company will meet with the unanimous approval of those who have the pleasing prospect of a rapid, reliable and smokeless system of transit before them is assumed. Chicago, better than any other American city, has had an opportunity of judging of the practical operation of an elevated electric system, and it cannot be regarded otherwise than as a triumph of the Intramural road at the fair that electricity has won a victory over the old style of elevated transit. Although it does not necessarily imply that the particular system used at the World's Fair will be employed on the new road, the choice of the company proves conclusively that electricity as a motive power has won the confidence of capitalists and its general adoption may be regarded as probable in future enterprises of a similar character.

The Northwestern Elevated Railroad company is capitalized at $15,000,000, and the ordinance just passed gives the company authority to build nearly 45 miles of elevated tracks in the northern and northwestern portion of the city. The proposed route includes a main line and four branch lines and is as follows:

First—For the main line of said railroad, commencing at Congress street, or at a street or point north of Congress street and between Wabash avenue on the east and Market street on the west, and extending in a northerly or northwesterly direction to the Chicago river, thence across the Chicago river to a point between Cass street, extended to the Chicago river, and the north branch of the Chicago river, thence extending in northerly or northwesterly direction to the city limits.

Second—The first branch of the said railroad shall commence at the main line at a point north of Van Buren street and south of the Chicago river, and run west across the south branch of the Chicago river to a point not more than 1,000 feet west of Halsted street, and continuing with two branches, one running northwesterly to the city limits and one running northerly to the city limits.

Third—The second branch shall commence at the main line between North avenue and Chicago avenue, and extending in a westerly direction to a point between Western avenue and Ashland avenue, thence in a northerly direction to the city limits.

Fourth—The third branch shall commence at the main line between North avenue and Diversey street and extend in a northerly or northeasterly direction to the city limits.

Fifth—The fourth branch shall commence on the main line between North avenue and Belmont avenue and extend westerly to the city limits.

The ordinance also gives the company the right to cross the Chicago river on own bridge, through a tunnel, or on one of the existing bridges, provided that if an existing bridge be used, it shall be in such a manner that traffic shall not be interfered with. It is provided that a five cent rate of fare shall be established on the main line in conjunction with the branches.

The incorporators of the company are: Frederick Sargent, late electrical and mechanical engineer of the World's Fair; B. J. Arnold, designer of the Intramural plant at Jackson Park; W. M. Anthony, controller of the Chicago Edison company; Harold Sturges, of the American Battery company, and Edward W. Russell, the attorney. It is believed, however, that D. H. Louderbach is the principal promoter of the scheme, and that a number of leading Chicago capitalists are also interested.

Mr. Louderbach has been associated with a great number of electric street railway enterprises, and his name appears as the projector of a company recently incorporated to build a number of surface electric roads in the North Division. Samuel Insull, president of the Chicago Edison company, and John L. Cochran, a dealer in Edgewater real estate, are associated with him in that venture. It has been suggested that these surface lines will be used as feeders to the elevated road and its branches. Mr. Louderbach does not deny that he regards it as advisable to make a connection with his North Shore line, which runs from the end of Mr. Yerkes' horse car tracks at the city limits to Evanston, a distance of about eight miles.

In reference to the rumor that Mr. Yerkes was interested in the line Mr. Louderbach has stated positively that it will be independent of that gentleman's system.

At a meeting of the board of directors held January 1st Mr. Louderbach was chosen a director in place of Frederick Sargent, resigned, and elected president of the company. E. M. Russell was at the same meeting made secretary.

Electricity at the World's Fair.

With some delay caused by trouble in getting cars, the electrical exhibits at Jackson Park are being rapidly removed. Nearly all of the material belonging to the General Electric company has been taken from Jackson Park, including the apparatus used in contract work. Lieut. E. J. Spencer still remains in charge of the company's interests at the exposition despite the published report that he had opened an office in St. Louis. He now makes his headquarters at the company's Chicago office, 173 Adams street, where he will remain for some time.

Lieut. O. G. Dodge, of the navy, late chief inspector of the electrical engineering department of the World's Fair, has been appointed a member of a naval board which is to inquire into the advisability of using electrically transmitted power for the operation of the machinery in the Brooklyn and Norfolk navy yards. The other members of the board are Commander Washburn Maynard and Lieut. J. D. Murdoch.

Many reviews of the electrical features of the fair are now appearing in the technical and popular journals of the country, and one of particular interest has just been published in the retrospective World's Fair number of the *Engineering Magazine*. It is from the pen of Prof. Elihu Thomson, and is written with that charming lucidity of style which always distinguishes the technical articles of Prof. Thomson. The greater part of the article, which is entitled "Electricity in 1876 and 1893," is herewith reproduced:

The Centennial will be remembered in the history of electrical progress on account of the fact that the telephone of Alexander Graham Bell became then for the first time known as an accomplished fact. It spoke with a small voice, it is true, at the Centennial exhibition, but the echo of that voice was heard over the civilized world. The telephone had been invented just in time to date its birth from 1876. Dr. Elisha Gray, who was close upon Bell in the invention of the telephone itself, was exhibiting his harmonic telegraph, a very ingenious multiple telegraph, but the chief interest soon centered on the instrument that could talk. With the advent of the speaking telephone there seemed to come about a general awakening to the capabilities of electricity in practical work. It prepared the public mind for the coming of new wonders. It attracted attention to other electrical enterprises and to a large extent wiped out the factor of conservatism in relation thereto. Indeed, the telephone had scarcely begun to be used practically before the announcement of the invention of the Jablochkoff candle drew attention to the field of electric lighting, and in 1878 the Avenue and Place de l'Opera, lighted by electric candles, constituted one of the great achievements of the Paris Exposition year. The Jablochkoff candle did not, however, realize expectations; it was too costly, and soon gave place to ordinary arc lamps run in series. Much pioneer work in this field was done in this country by Charles F. Brush, of Cleveland, who in 1879 had as many as sixteen arc lamps running in series from one of his well-known dynamos. A few other inventors were almost equally early in this work.

It was toward the close of 1879 that Thomas A. Edison succeeded in accomplishing the task which he had undertaken and upon which he had been at work for a year or two. This was the invention of a small electric lamp giving a light of about the same candle power as a gas-jet, and capable of being run in multiple with many others, without requiring too large a current or too frequent renewals of the lamp. Such a lamp to be commercially successful needed to be of low first cost, economical of power, and easily reproduced in large numbers. No one, unless he has been engaged in similar undertakings, can begin to realize the amount of effort, self-sacrifice and hard work which must have been required not only to perfect the lamp itself and the details of its manufacture, but to provide suitable generators, regulators, distributing systems, mains, safety-devices, and the other things which go to make complete the electrical equipment of a lighting installation—a revolution in lighting means and methods. That Mr. Edison and his able assistants undertook and accomplished this work, the records of the numerous inventions in this field would be sufficient evidence, did we not have the fact of the actual accomplishment as a matter of engineering history.

It would be beyond the scope of the present paper to trace the history of the innumerable developments in the electrical field brought about by the effort and genius of a great army of workers, both here and abroad, between the years 1876 and the present. It must not be forgotten either that, aside from the great engineering triumphs which are from their practical benefits sufficiently prominent, electrical science, purely as a science, has expanded and progressed apace.

The advance, though a rapid one, has been sufficiently gradual to allow us to note the process as more of evolution than revolution. The great exhibitions held within the period between 1876 and 1893 have embodied more and more electrical arts and productions. Add to these the specially electrical exhibitions—as in Paris (1881), Philadelphia (1884), and Frankfort (1891)—and the growth becomes evidently a gradual unfolding. It was natural, then, not only that the World's Fair of this year should have been characterized by progress in all arts, but that it should have become more distinctively electrical than any preceding international display. It is to be doubted, however, if many were prepared to find that such dependence on the work of the electrical engineer would be shown.

Whether we regard the lighting of the vast areas and spaces in and around the great structures in Jackson Park, or the transportation by rail or water within its boundaries, or the distribution of power for various purposes, it was through the agency of electricity that these objects were attained. In fact, the great bulk of the steam power developed was to give motion to the dynamos for furnishing current for all the various uses to which, in these days, electricity has been applied. It is certainly no exaggeration to say that the vast amount of mechanical power developed and used at the World's Fair was mostly used for electrical purposes or transmitted electrically for its ultimate use. A vast area in the mechanic arts building, covered with engines and dynamos driven thereby, directly adjoined the boiler houses and formed for the time, as it were, the most gigantic electric station ever installed. From it was sent out current for several thousands of arc lights, for from 50,000 to 100,000 incandescent lights, for innumerable electric motors working elevators, driving machinery of all kinds, ventilating, for charging storage batteries, for electric welding, forging, heating and other uses.

At the Centennial in 1876 no perceptible fraction of the power was electrically used. At the World's Fair it had become almost wholly electrical. The arrangement of the great Corliss engine at the Centennial was in the middle of the machinery building, and by a complex system of gears and belts the power was transmitted and delivered to the long lines of shafting extending each way from this central power source. This was a limitation of service arising directly out of the absence of electrical transmission. At the World's Fair, on the other hand, power could be delivered anywhere by the use of electric motors, and the moving machinery was not therefore practically restricted to a building in which a steam-engine was at hand.

In 1876 arc lights were a curiosity and but rarely seen. In 1893 their use for use for illumination of streets and large spaces is almost universal. Never has there been, however, any greater display of arc lighting than in the present year at the World's Fair. The whole of Jackson Park was dotted over with these miniature suns at night and the interiors lighted. Under the roof of the manufactures and liberal arts building were five large coronas comprising many arc lamps each, a unique display in itself and an economical arrangement as well. About 2,000 arc lights, if I mistake not, were employed in lighting the gigantic structure throughout. The great searchlights, with their 60-inch mirrors reflecting the light from specially large arcs in their foci, were a striking feature of the illuminations, and these artificial sunbeams were of an intensity never before approached.

The whole art of lighting by electric incandescence has come into existence since 1876. Incandescent lamps can now be made of such uniformity of voltage and energy consumption as even to dispense with any need of photometric measurement, and indeed to require no testing or sorting after manufacture. Such lamps may consume about 3½ watts per candle and have a useful economical life of over a thousand hours of service. An achievement like this means attention to many small details, and the doing of delicate work on a large scale. Astonishing it is to find that frequently in such work what was formerly a delicate laboratory manipulation becomes everyday work room practice; and here constant practice of delicate operations by even ordinary labor results finally in almost perfection.

The larger part of the incandescent lighting of the World's Fair—and the little bulbs were everywhere used and useful—was carried out on the alternating current plan so commonly employed in cities and towns where the electric station must be at a considerable distance from the mass of consumers. Huge dynamos in the mechanic arts building supplied the alternating current at high pressure in mains leading to the transformers, located in receptacles in the ground, from the secondary circuits of which the low pressure currents were fed to the lamps connected thereto.

At the time of the Centennial alternating currents were known—and dynamos yielding such currents were known, being among the earliest invented—but the transformer was unknown. The nearest approach to it was the induction coil for shocks or medical use and the Ruhmkorff coil. Soon after the invention of the telephone, however, the induction coil, modified and used in conjunction with carbon transmitters, enormously increased the distance over which speech could be successfully transmitted, and has led in 1893 to the regular communication by telephone over distances more than a thousand miles, while such is the delicacy and fidelity of transmission that it is not necessary to speak much above a whisper at New York or Boston to be heard in the receiver at Chicago.

The transformer, or modified induction coil, has, in like manner, rendered possible the economical transmission of electric energy to great distances, as the working of low voltage incandescent lamps at miles of distance from the supply station. Otherwise the line losses and excessive cost of mains would in such cases forbid the use of direct supply. The perfection to which this useful apparatus, the transformer, has been brought by careful work may be judged from the fact that it often has an efficiency between 97 and 98 per cent. at full load. It is a

simple affair of copper wire and sheet-iron, apparently, but it has required much study and experiment to bring it to the present state of perfection. There is little or no opportunity for further advance. The very great expanpansion of incandescent lighting both by the direct supply systems and transformer systems during late years is sure to continue at an increasing rate in the future until it includes a large proportion of the lighting done in cities and towns.

In 1876 the storage battery was practically unknown. A crude form devised by Planté had been experimented with for a considerable time before, in the laboratory. The eminently successful use made of the electric launches on the lagoons at the World's Fair was an ample demonstration that in the past few years a new field for electrical work had been opened up. The application of the battery to boats is of course but one of the uses for the modern storage cell. Many electric stations in Europe and a few in the United States have within late years added an equipment of batteries to work in conjunction with their dynamos in giving out current energy when the consumption is heavy, and to absorb energy or become charged from such machines when the consumption is small. This in a large measure prevents overloading at one time or the running of the machinery with loads too light to be economical at other times. How far experience will confirm the apparent advantage of such a plan remains to be seen.

The largest single exhibit of an electrical nature was, without doubt, the Intramural railway and its power house—together a grand practical exemplification of electricity applied to traction. It was remarkable in many ways as a piece of engineering and operated with the greatest success. It emphasized the fact that the days of steam locomotives on elevated roads in cities are numbered, and that just as surely as the horse-car has given place to the trolley-car, so must the electric motor supplant steam propulsion on the roads in question. Yet in 1876 there was no hint or suggestion of such extended use of electricity on railways—and, in fact, no such application had been made. On the Intramural road a conductor rail with the ordinary rails for return circuit was used, the current being taken up by sliding shoes bearing on the conductor rail. The motor car at the head of each train, besides the ordinary seats, was provided with four electric motors, one geared to each axle individually, while the controlling mechanism was arranged so as to connect the motors in single series for starting and to make successive changes passing through intermediate connections until the one having all the motors in parallel was reached, the condition for maximum speed.

This arrangement, with refinements of detail especially designed for this work, and first put into full operation at the World's Fair, gave great economy as well as flexibility in the handling of the trains. One of the best illustrations of the progress in the art of electrical engineering in the past few years was the building in the station of the intramural road of the great direct-coupled continuous current dynamo of 2 000 horse power capacity. This machine—by far the largest continuous current dynamo ever made—was lately described by its designer, Horace F. Parshall, in this magazine (September, 1893). It is a comparatively simple undertaking to design and construct very large alternating current generators, since in many respects they are like duplications or enlargements, simply, of the elements of smaller similar machines. This is not so with continuous current types, as the problems of armature reaction, air gap, and self-induction as affecting the working of the commutator at various loads have to be carefully estimated, while the relation of turns on the armature to number of segments in the commutator, the proper proportions and construction of the commutator itself, and the other proportions, have to be studied with great care and adjusted within limits. All this makes the production of so large a machine, built as it was without previous experiment, and its parts put together even to the assembling of the sheet-iron pieces of the armature, in the station itself, a veritable triumph of engineering skill.

Speaking generally, it is not far from the truth to say that at the World's Fair there was as much to be seen of electrical application outside of the electricity building as within its walls, though this building was itself a temple of electricity. There were, it is true, a number of exhibits of no special significance, such as those of shifting light in masses of incandescent lamps, obtained by complicated switching appliances, colored lamps being freely used. The most artistic display of the kind was the Edison tower of lights, a creditable piece of work, the effects obtained from which were certainly very striking and beautiful. The large and varied display of modern electrical apparatus and machinery, together with the various historical exhibits, were of deep interest to the student or engineer. There were found a fully equipped modern telephone exchange and also Dr. Gray's "telautograph," which is in a certain sense an intended rival of the telephone. There also were found many types of dynamos of various makers both here and abroad. Electric motors were found applied to all manner of work—pumps, hoists, elevators, locomotives, and mining machinery generally. Electric arc lamps and machines, carbons, of all leading makers, were here together with exhibits showing many forms and patterns of incandescent lamp, lamps of low voltage to lamps of high voltage, lamps with one filament to lamps with a dozen filaments, lamps of one candle power to lamps of hundreds of candle power, etc. There were full lighthouse equipments with their huge compound lenses on view. On the one hand was to be found appliances for generating electricity of enormously high pressures, such as would leap in torrents of sparks over more than five feet of clear air space, and on the other hand apparatus for electric welding and metal-working capable of yielding currents of 50,000 amperes with pressure as low as two or three volts. The comprehensive exhibit of practical work done in electric welding, including the largest weld ever made by electricity, in which the section at the weld was 48 inches of steel, was of great interest to many practical men.

A number of creditable exhibits of alternating-current motors of such type as single-phase, diphase and triphase construction were found, so that the respective characteristics of this most interesting of the recently developed forms of alternating current apparatus could be examined. This class of electric machinery is of so recent production that we must look to the future for its wide application. Everywhere in electricity building was evidence of enormous growth of electrical industries. It could be partly understood from the variety of such things as switches, safety cut-offs, wires, cables, insulating materials, found there, aside from the heavy machinery.

In the department of measuring instruments alone, the progress to be noted was remarkable. Ammeters, voltmeters, wattmeters, recording wattmeters, standard resistances, standard cells, electrical balances and bridges, of the highest degree of excellence, were not wanting. With the refined means of measurement so provided the estimation of electrical forces and quantities may be made with a rapidity and precision hardly equalled in any other department of physical science. Enough has been said, however, to indicate what a harvest has, in the past few years, been the outcome of the earnest effort of brain and hand in the electrical field.

The one discordant note in all this great display of genuine scientific and engineering work was found in the fact that in this same temple of science—in electricity building itself—naked imposture, quackery in the form of so-called electric belts, hairbrushes, insoles, and what not, had obtained a footing and stalked forth unabashed. No words of condemnation can be too strong to be applied to the parasites, who in the guise of healing and benefaction, succeed in extracting perhaps the last money from the sick and suffering for their worthless trumpery. The fact that such exhibits were found in 1893 holding place alongside of genuine electo-therapeutic appliances of undoubted merit only heightened by contrast the great shame of their presence.

Within the limits of the present article it has manifestly not been possible to do more than briefly refer to such electrical features of the World's Fair as show in concrete form the great advances which have taken place since the Centennial year.

Our technical schools and universities now devote to the teaching of electricity as a branch of engineering special courses, special laboratories, special instructors. Formerly the little electrical knowledge taught was taken up as a department of physics.

In this present year the arc lamps in use are numbered by the hundred thousand, incandescent lamps by the million, while millions of passengers are carried daily on electric cars, thousands of horse power transmitted and distributed by electric motors, thousands of tons of metal refined annually by electrolysis, chemical decomposition on the large scale effected, as in the production of cheap aluminum, electric furnaces are turning out their special products, such as carborundum of diamond-like hardness and active electric welding and metal-working machines are in service in a large number of manufactures.

In summing up this great growth we must not forget the enormous extension of telephone service systems in the past few years. So great have been the advances that it is natural to expect that in the immediate future similar rapid and important work will be undertaken and accomplished. It is difficult to play the role of a prophet unless the prophecies be made so numerous that some of them cannot fail of realization. There are, however, some things concerning future electrical development about which we can be positive. It is not likely that, except in details, much advance will be made in dynamos and motors. The efficiency of well designed types is now so high as to leave very small opportunity for improvement. Large dynamos at full load have commercial efficiencies ranging from 95 to 97 per cent. Transforming apparatus of various types may readily have at full load a net efficiency of 97 per cent. The possible efficiency of arc lamps is about reached—and with the incandescent lamp the volatility of carbon at high temperatures governs the efficiency and life. The higher the temperature the more efficient the lamp, the more volatile the carbon of the filament, and the less will be the life of the lamp. It is unlikely that any better material than carbon will be found for the filament, and the properties of carbon as to volatility can probably not be changed.

The cost of these lamps is now about as low as is consistent with good quality and uniformity. The use of transformers for raising or lowering the line potential, permits long-distance transmission of electric energy with moderate loss. The conditions of the most efficient use and operation of electric motors as a source of power when transmitted have been well worked out, so as to leave but little further to be accomplished in that line.

We can hardly expect, therefore, to make any radical gain in the operation of electric plant unless by the utilization of new principles in unexplored fields. A substantial gain in the economy of the development of power from fuel is of much greater moment than any possible gain in the efficiency of the electric plant. Hence electricians are looking for cheaper power, as that and that alone now means cheap electricity. For the same reason attention is more than ever concentrated on the utilization of water power, as of Niagara itself by the Cataract Construction company. Much future work will be done in this field, and it will give rise to many new problems for solution by the electrical engineer. The laboratory work of to-day becomes engineering work of to-morrow. Work which to-day is in the experimental stage reaches its full commercial completeness only after considerable practice with it under varying conditions. The advance work goes steadily on, but in channels which demand more and more intricate knowledge of electric actions. It is the fervent hope of many an electrician that, at no very distant time the energy of fuel may be converted more directly into electric energy, and without the enormous percentage of loss that is involved in present methods and that some means may be found to further transmute the electric energy into light with but a small percentage of dark heat, instead of present wasteful methods; but this is still a hope only, and there is not even a probable solution indicated.

In the department of electrical engineering work the early future will, I think, witness, in addition to a constantly increasing use of electricity for illumination, further application to chemical and metallurgical work. The field for the application of electricity to mining, for hoists, for pumping, drilling, mine haulage and the like is very wide. While it is not probable that the steam locomotive for long distance railroading will soon be supplanted by electric locomotives, still there is a growing interest in these latter as applicable to special cases, such as specially-designed high-speed roads between populous centers, for tunnel work and elevated roads in cities. As feeders for trunk lines of railroad it would seem that trolley lines are admirably adapted both for passenger and freight service, and their employment in this way will doubtless become of great importance in densely peopled localities.

There is also a field for the application of electricity stored in batteries to propulsion of road vehicles, a field in which but little has hitherto been done. Electricity generated under present conditions, involving in the first conversion into mechanical power such an enormous loss of heat energy of the fuel, will evidently not be applied as a general heating agent. In certain cases, in which the disadvantage of high cost may be outweighed by superior advantages of application, as in cooking by electric heat, there may result a considerable extension of its usefulness. But that it can be economically applied simply to heat metal bars for forging in a drop-press or rolling-machine, is not at all to be expected. In special cases of distinctly local heating of metal for welding, bending, or other process, it is now not only used with success and economy, but it would appear that many additional applications of this kind will be made in the future.

While it may be reasonable to look forward to the ability to telephone through an ocean cable under the Atlantic, it is hardly likely that we shall travel over it in ships propelled by electricity. It would indeed be possible to construct electric motors able to turn screws and propel our largest ships, but the supply of current energy to them at the rate of ten to twenty thousand horse power, for five days continuously would require a storage battery to be carried such as would be enormously costly and so heavy that it could not be placed aboard without sinking the ship. It should, however, be borne constantly in mind, in dealing with the subject of electrical applications, that a new discovery might at any time change the aspect of every prophecy based on present knowledge and conditions.

American Electro-therapeutic Association.

The secretary of the American Electro-therapeutic association has sent out a circular showing the committees of the association and the work assigned to them. This statement, which gives a good idea of the work undertaken by the association, is as follows:

COMMITTEE ON STANDARD COILS.

Dr. W. J. Morton, 19 East 28th street, New York.
Dr. A. H. Goelet, 351 West 57th street, New York.
Dr. Wm. F. Hutchinson, Providence, R. I.
Dr. G. J. Engelman, 3003 Locust street, St. Louis, Mo.
A. E. Kennelly, chief electrician, Edison Laboratory, Orange, N. J.

Points to Be Considered.

I. Portability.
II. Practical mechanism of machines as adapted to physicians' use.
III. Range and rate of vibration.
IV. Electromotive force and its range in relation to resistances to be overcome.
V. The resistance of the coil producing these electromotive forces.
VI. The battery power required for individual coils.
VII. Shape of the generated wave of electromotive force.

COMMITTEE ON STANDARD METERS.

Dr. Margaret A. Cleaves, 68 Madison avenue, New York.
Dr. Emil Heuel, 352 Willis avenue, New York.
W. J. Jenks, electrical engineer, 44 Broad street, New York.

Points to be Considered.

I. A good meter should have a clear, legible scale, fairly uniform over the range, and not crowded at different points.
II. It should be capable of being noted or observed at a distance.
III. The resistance should be low.
IV. There should be no tendency to overheat with the strongest current employed.
V. It would be advantageous to avoid a shunt, if one milliampere can be read throughout the scale.
VI. The instrument should be capable of indicating in all positions.
VII. Any instrument whose indications depend directly upon the local magnetic force is objectionable, for the reason that its indications are liable to be affected by iron in the vicinity.
VIII. The suspended system should require as little attention as possible, either for adjustment or shipment.
IX. It is an advantage for the instrument to indicate with either direction of the current.
X. Portability.
XI. Liability to fracture.

COMMITTEE ON STANDARD ELECTROSTATIC OR INFLUENCE MACHINES.

Dr. W. J. Morton, 19 East 28th street, New York.
Dr. J. H. Kellogg, Battle Creek, Mich.
Dr. G. Betton Massey, 212 South 15th street, Philadelphia.
Dr. Margaret A. Cleaves, 68 Madison avenue, New York.

Points to be Considered.

I. Electrostatic machine best adapted to medical work, to be determined by its output. Its output to be determined as follows:
(*a*) At, respectively, 100 and at 150 revolutions per minute.
(*b*) With two Leyden jars, each of whose outer metallic surfaces has the area of $4\frac{1}{4}$ by $1\frac{1}{8}$ inches = $5\frac{5}{8}$ square inches.
(*c*) With discharging-rods having ball terminals one inch in diameter and arranged respectively six inches and ten inches apart.
(*d*) Give the number of sparks per minute which will pass between the discharging-rods.

II. Give the greatest maximum length of spark with machine arranged as in Section I, except as to distance apart of the discharging-rods.
III. Give the maximum length of the brush discharge between the discharging-rods with machine arranged as in Section I, except that no Leyden jars are used.
IV. Give the maximum length of spark that may be obtained by a brass-ball electrode two inches in diameter, from a person's back, seated in the usual manner upon an insulated platform—the platform connected to one prime conductor of the machine, the other being connected to the ground.
(*a*) With above Leyden jars.
(*b*) Without Leyden jars.
V. Kind of electrostatic machine best adapted to medical work, whether a Holtz, Wimshurst, Toepler, Voss, Carre, Lewandowski, Toepler-Holtz, Wimshurst-Holtz or machine not here named, provided the type as constructed successfully fulfills requirements outlined in Section I.
VI. Does the machine preferred easily reverse its charge? Does it maintain its charge successfully?
VII. Facility and means of charging machine under all atmospheric conditions.
VIII. Can a good meter to measure the output of the machine be suggested?
IX. Mechanical construction of machine.
(*a*) Ease of actuating machine by motive power.
(*b*) Durability of the mechanism causing the revolution of its plates.
(*c*) Durability of its construction.
(*d*) Is a glass case necessary?
X. The best means for drying the air within an enclosing glass case.
XI. The best means for absorbing the ozone and nitrogen compounds formed within a glass case.
XII. Is it not advisable to decide in a general way that no machine, the diameter of whose revolving disks is less than 26 inches, and the number of whose disks is less than six, should be recommended by this committee for medical work?
XIII. Suggestions as to a practical switch for the utilization of Morton's static induced and the transformer currents.

COMMITTEE ON CONSTANT CURRENT GENERATORS AND CONTROLLERS.

Dr. W. J. Herdman, 48 East Huron street, Ann Arbor, Mich. Current controllers and battery tests
Dr. Robert Newman, 68 West 36th street, New York. Primary stationary batteries.
Dr. D. S. Campbell. Correspondence with physicians.
R. G. Brown, E. E., Brooklyn, N. Y., Stationary batteries and dynamos.

Points to be Considered.

I. Primary batteries.
Express what preference for a certain form of battery and give reasons therefor.
Determine voltage, internal resistance, current and durability.
By what accessory appliances are currents from these batteries best controlled and applied?
II. Secondary batteries.
What are the defects and inconveniences?
What the advantage over other forms?
What the ampere hours, what the constancy, voltage and action?
III. As to dynamo currents.
What the nature of the current, what its voltages, how is it modified by the form of controller under consideration? What are its physiological effects and its therapeutical application?
IV. Report new forms of batteries and improvements, with claims as to superiority over those now in use.
V. Rheostats and controllers.
Test the various forms and devices used and recommended to modify and control currents; difference in effect produced by each, mechanically, chemically, physiologically, or therapeutically.

COMMITTEE ON STANDARD ELECTRODES.

Dr. A. Lapthorn Smith, 248 Bishop street, Montreal, Canada.
Dr. Charles R. Dickson, 263 Victoria street, Toronto, Ontario.
Dr. Plym S. Hayes, 84 Washington street, Chicago, Ill.

Points to be Considered.

I. Inactive electrodes.
1. What is the best material in general for the groundwork of the electrode, and what in special cases?
2. How may it best be connected with its rheophore?
3. What is the best material to cover its conducting surface?
4. When necessary, how may it best be insulated?
5. In what way may it be be kept warm and moist when not in use, should this be necessary?
6. What should be accepted as standard sizes and shapes, and how best designated?
7. What other points require to be considered?
II. Active electrodes.
1. What is the best material in general and in special for the ground-work of the electrode?
(*a*) When used at the positive pole?
(*b*) When used at the negative pole?
2. How may it best be connected with its rheophore?
3. What is the best material to cover its conducting surface when necessary, in general and special?
4. How may it be insulated when necessary?
5. What is the best form of construction where flexibility is required for tortuous canals?
6. What shall be considered the standard shapes and sizes? What scale shall be adhered to in considering the latter? How may their surface area be estimated when they are of irregular shape?
7. When designated by numerals as to size and surface, how may such best be expressed when stamped or otherwise marked on them?
8. How may simplicity of construction be best obtained and cost of manufacture reduced without impairing efficiency?
9. How may facility of cleansing and rendering aseptic best be achieved?
10. What other points to be considered?
III. Active and inactive electrodes.
1. Are the terms "active" and "inactive" the best standard terms we can employ.
2. In the case of both active and inactive electrodes, should not the threads of all screws used in construction as a means of attachment, also all plugs and sockets, etc., be of a standard gauge, that electrodes might be used with attachments of all makes, etc, and to facilitate repair.

COMMITTEE ON ELECTRIC LIGHT AS A THERAPEUTIC AND DIAGNOSTIC AGENT.

Dr. Plym S. Hayes, 84 Washington street, Chicago.
Dr. Margaret A. Cleaves, 68 Madison avenue, New York.
Dr. H. H. Hahn, 304 E. Federal street, Youngstown, Ohio.

Points to be Considered.—Therapeutics.

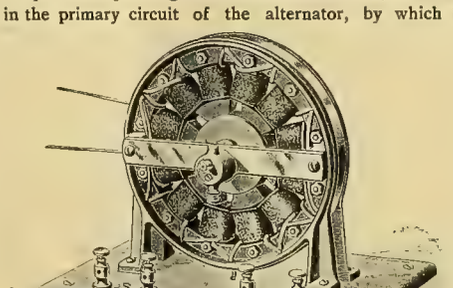
I. How can the heat of the incandescent and arc light best be utilized in the treatment of disease?
II. (*a*) What form of apparatus is best adapted for the use of the electric light in the treatment of disease?
(*b*) Is there any difference in the therapeutic effects of the incandescent and arc lights?
(*c*) Does the coloring of the light, by causing it to pass through colored glass or similar substances, add to the efficacy of the light?
(*d*) Is the light and heat derived from the electric light different or of greater therapeutic value than that derived from any other source?
(*e*) What pathogenic germs have their growth arrested or are killed, by continuous exposure to the influence of light?
(*f*) Can a disease produced by the above mentioned germs be modified or arrested by the continuous exposure to light?

Points to be Considered.—Diagnosis.

I. Illumination by means of a combination of the electric light reflectors and condensers so arranged as to furnish parallel or convergent rays of light. What form of apparatus is best adapted for general use? what for special?
II. What are the best forms of apparatus for illuminating the various cavities of the body, and at the same time enabling the physician to obtain a view of the whole or part of the cavity?
Is the heat evolved, from the lamp employed, of sufficient intensity to require especial means for its absorption?
III. To what extent is the introduction of an electric light into the various cavities of the body, in order to determine the condition of those cavities or the translucency of the surrounding tissues, of advantage?

Kennelly Therapeutic Alternator.

The accompanying cut illustrates an alternator designed to be used for therapeutical purposes, and manufactured by the Edison Manufacturing company, New York. The machine, which can be driven by a small motor from a battery of eight cells, or from a small motor on an incandescent circuit, is intended principally for the production of sinusoidal alternating currents in electro-therapeutic treatment. The electrical energy required to operate motor and alternator at full power is six amperes at 4½ volts. The field frame of the machine is of laminated iron supported by castings, and has twelve poles. Twenty-four alternations are produced at every revolution of the armature, and the frequency can be carried to 960 periods per second. A rheostat of wire for battery circuits, or of lamps when operating from incandescent mains, is included in the primary circuit of the alternator, by which the



KENNELLY THERAPEUTIC ALTERNATOR.

strength of the secondary currents can be controlled independent of the frequency.

The sensations that are produced by the application of this instrument differ radically from those which result from the employment of an ordinary faradic coil. They are much softer, it is said, more agreeable, equally developed at either pole, and generally exhibit the characteristic sensations attributed to sinusoidal currents. The electromotive force attainable in the secondary coils amounts to 50 volts, but on closing the secondary circuits, under the conditions of ordinary application, the voltage at the secondary terminals falls proportionately to the amount of external resistance.

Electric Lighting for the Capitol at Washington.

At the last session of Congress the committee on rules of the Senate enlisted the services of competent electrical engineers, for the purpose of ascertaining the amount of an appropriation necessary to establish an electric plant for the purpose of illuminating the capitol. Several reports have since been made, and definite action is soon to be taken by the Senate. It is said to be likely that the committee will recommend the immediate establishment of an electric lighting plant of sufficient power not only for the capitol building, but for its annex, the Maltby house, and the congressional library, which is to be the largest building of its kind in the world, and which, by reason of its uses, will require the best class of illumination.

To accommodate such a plant it will be necessary to locate the engines and dynamos in a structure erected for this especial purpose. The location of the power house is now being carefully considered, and the decision will probably be reached very shortly. The station will be ornamental in appearance, and will be of sufficient size to contain not only the dynamos necessary for the present, but also for other buildings that may be added to the group clustered around the capitol, notably the home for the Supreme Court.

A careful estimate has placed the original cost of the building, machinery, wiring and general installation of the plant at $200,000. This will insure work of the best character and a plant of sufficient capacity to furnish all the light needed in the buildings and grounds. The latter is a most important item in the calculation, for at present there is an utterly inadequate illumination of the great park.

It is estimated that not only will the new plant give a better and more wholesome light, but it can be maintained considerably cheaper. The most recent annual report of Architect Clark shows that the yearly cost of lighting the capitol and grounds and Botanical Garden is $24,000, or just as much as is appropriated. The real necessity is in fact more than this, and the cost averages about $26,000, thus creating a deficiency yearly of about $2,000. Of this sum the gas service alone amounts to $15,776.37. The pay-roll for lamp lighters, gas fitters, etc., aggregates $2,681, and the pay of the attendants of the electric lighting plant that is now established in the building amounts to $3,276 45. This plant is rented from the Westinghouse company at an annual cost of $874.19, and last year $349.96 was paid for extensions. The fuel required ranged in price between $1,800 and $2,000. A rough estimate of the cost of maintaining the new plant, which will do not only the work now done by the gas and electric plants in the capitol building, but also the entire work of lighting the new library building and the Maltby House, shows that it will cost in the neighborhood of $19 000. This is on the basis of 150 session days during the year and an average duration of six hours per day.

The electric plant now in the capitol building was placed there a few years ago as a "six months' exhibit," and at the end of that time it was arranged for the government to rent it. There are two dynamos on either side of the capitol, and they are now often overloaded. There are now about 1,750 lamps in the capitol building, but these illuminate only a small part of the structure, and in a great majority of the committee rooms that are almost secluded from the light of day there is nothing but gas of questionable quality for the giving of light. Gas is used in many of the file rooms and document rooms and other places where the most valuable papers are stored. Matches have to be used to strike a light, and a stray draught might at any time cause untold damage. The plan contemplates the introduction of about 15,000 lamps in all the buildings. This will give ample illumination to every room in the capitol and the new library building.

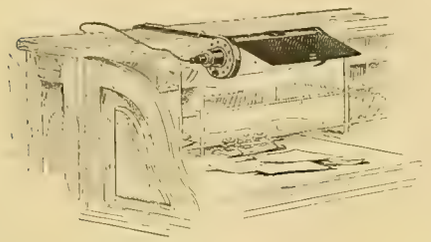
For more than ten years the dome of the capitol has never been fully illuminated. This has not only been due to motives of economy, but on the ground of the safety of the building. The gas pipes that run through almost every part of the interior surface of the dome are old and corroded, and in many cases absolutely worn out. The dampness of the interior and the constant draughts and lack of attention has combined to sprinkle them with leak holes, so that whenever the gas is turned on much escapes. When the dome was last lighted several years ago, at the moment the electric spark was sent through the wires there was an explosion that startled everybody for rods around the building. The upper portion of the dome seemed to be in flames. The escaping gas had mixed with the air, and a single spark was sufficient to ignite this and make the dome shake to its foundation. It would cost upward of $20,000 to repipe the dome. With the installiation of the electric plant it will be possible to illuminate the dome with perfect safety at any time, and thus make this beautiful structure a dazzling spectacle.

Under the new system the lighting of the chambers will be on much the same plan as at present. There will be groups of incandescent lamps located above the stained glass roofs in each house, and these will furnish the same soft mellow glow, though of greater intensity, than is now given by the gas. In addition there will be hemispheres of opalescent glass on the pilasters in the chamber itself and in the galleries, which are now sadly in want of illumination. One great advantage of the electric lighting system will be the decreased amount of heat in the lighting chambers above the ceiling. The hundreds of gas jets now in use emit a great amount of heat, and not long since one of the large panels of glass cracked immediately after the gas was lighted, and the pieces fell to the floor, barely escaping the head of one of the members. The breaking was caused undoubtedly by the sudden expansion of the cold glass when the heat from the burners reached it.

The inhabitants of the various coral islands in the southern Pacific will soon be acquainted with all the latest advances of civilization in the way of electric light, as the new steel auxiliary screw steamer "John Williams," belonging to the London Missionary Society's South Sea Mission, has a complete installation fitted on board. The vessel itself is of 700 tons burden, and was built by Messrs. Napier & Sons, Govan, and was launched on November 11th last.

A Convenient Desk Lamp.

The points of value in the device which is illustrated in the accompanying cut may be noted at a glance. The arrangement is known as the Kinsman desk light and embodies many novel features which give it advantages over the ordinary styles of portable desk lights, shades or reflectors. It is clamped to the desk as shown in the illustration and does not mar or interfere with the desk in any way. It has an adjustable arm which enables the cylinder to be pushed back or forward as desired. The inner glass cylinder is so arranged that it will give a bright light or by a slight adjustment it may be modified to a convenient intensity. These desk lights are made in several styles and are adapted for use in lighting pianos and paintings,



CONVENIENT DESK LAMP.

and also serve as excellent lamps for students. The device is put upon the market by McLeod, Ward & Co., New York.

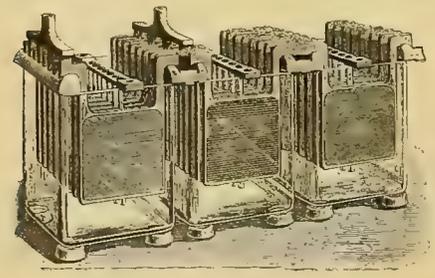
New Accumulator.

The accompanying cut illustrates a new form of accumulator just introduced by Gadot & Pisca of Paris. The plates, which are very thick and strong, are made with horizontal groves which are filled with active material. The plates are so arranged that a free space is left below them in the containing vessel, as the illustration shows. Any active material that may become detached is free to fall to the bottom of the vessel, so there is no danger of short-circuits from this cause. The plates are separated by porcelain tubes. The connection from one cell to another is made directly to the plates, which are made in such a form that this is readily accomplished, and the use of bolts and nuts is thereby avoided.

CORRESPONDENCE.

New York Notes.

NEW YORK, December 30.—Lawson N. Fuller, who has come in conflict with the rapid transit commission upon several occasions, and who has been refused recognition by that body, has addressed an open letter to the commissioners with the evident intention of suggesting a practical way out of the rapid transit dilemma. Mr. Fuller in his letter finds considerable fault with the work of the commission, and pays particular attention to the figures which have been made public since the adoption of the plan for an elevated line as proposed by Mr. Bushe. The chief point, however, worthy of consideration in this gentleman's letter is his plan to obtain, as far as possible, the consent of property owners along the line of the proposed road, and at the same time waive their rights for damages. He cites in support of this plan the case of the American Bank Note company, which compelled the Manhattan road to pay heavy damages on a building



NEW ACCUMULATOR.

erected long after the completion of the road. He says: "I voice the opinions of all the property owners when I declare that there is but one way out of this rapid transit trouble. Get the consent of the majority of the property owners along the lines you propose to build, waiving their rights for damages; make your conditions of sale liberal; give anybody who will bid for the franchise two years to build to Fort George, two years more to Van Cortlandt Park on the same terms, four years more to the city limits on the same terms; then fix a sum to be paid yearly to the city by the entire system. On no other conditions will you ever get capital to build the road. Notwithstanding Commissioner Inman's impotent resolution against the Manhattan company, nineteen chances out of twenty, if it is ever built, the Manhattan company will have to build it."

Another portion of Mr. Fuller's train of argument is that the day it is determined to build as above, property will advance in value at the rate of $25,000,000 a year for the eight years of construction, so that at the completion of this period the city would be receiving in increased taxes about $2,000,000, added to the tax on the elevated structure, which would approximate $1,000,000, making a total of $3,000,000 a year income for the city. It is quite likely that the purchasers of the franchise which will be offered for sale, if any are found, will exercise the foresight to provide for damages which would result from the building of the road, but Mr. Fuller has at least laid out some very comprehensive plans for consideration.

There is a rumor that an effort will be made to secure the passage of a bill at Albany reducing the rate of fare on the elevated roads in New York to three cents. One of the men who believes that the companies can make money even at such a reduction presents the following statement in support of his views: "Reduced to comprehensive figures, the latest published report of the Manhattan Railway company shows the average daily income of the company for the year to be $29,273.91, and the average daily expenditures to be $14,863.96. Only receipts for passenger service are included in these figures. They do not include the receipts of the company for advertising and mail and telegraph service. New Yorkers are paying annually in profits to the elevated roads of the city between $5,000,000 and $6,000,000 over and above all proper expenses for operating and maintaining the roads in good condition, or in excess of 10 per cent on $50,000,000. The obvious conclusion is that the city should build, own and operate its own system of rapid transit lines. The cost of building a suitable structure, with proper equipment of rolling stock, cannot much exceed $500,000 a mile; at most $20,000,000 to $30,000,000 for forty miles of road. The roads would pay for themselves in a very few years at five cent fares, and thereafter the fares should be reduced to 3 cents. Let the city issue, in denominations of $1, $2 and $5, scrip books sufficient to build the roads, in amounts as may be necessary from time to time, as the work progresses. This scrip stock could be received by the city in part payment of taxes, and for other purposes, and again paid out, until finally redeemed in the service of the roads. It would pass current as a circulating medium, and would be absolutely safer than bank money, based, as it would be, on the value of the roads, the wealth of the city, and the service of the rapid transit lines. The metropolitan city of the American continent should set the world an example, and demonstrate to the elevated railway company that its millions are not sufficiently potent to impede longer the progress of this great city. New Yorkers should insist on rapid transit and three-cent fares."

Work is rapidly progressing on West One Hundred and Thirty-fifth street for the trolley road which seems to have been universally termed the "mushroom road," and all day long on Christmas day a gang of laborers continued to advance the line at a surprising rate. Much opposition has been raised to the road, but it appears to have had no effect on the plans of the projectors. The Union company intends to run cars from Eighth avenue and West One Hundred and Thirty-fifth street eastward over the Madison avenue bridge and through East One Hundred and Thirty-Eighth street to connect with the company's Third avenue line. The argument advanced in favor of the new branch is that it affords much needed facilities for cross-town travel. The opposition comes chiefly from property owners west of Lenox avenue. East of that point there are many vacant lots and the houses which have been built are less valuable than the substantial blocks between Lenox avenue and the westward terminus of the Union company's line. As a result the company encountered little difficulty in securing the consent of property owners east of Lenox avenue, and its success there, together with the few hundred feet secured west of Lenox avenue, has given, it is claimed, a consent governing more than half the lineal feet making up the route. At all events, President Edward A. Maher has contented himself thus far with the single statement that his company has all the consents necessary.

The Electrical Workers' University Extension Society has been formed by about 400 members of Electrical Workers' Union No 31, under the auspices of Columbia College, for the purpose of educating themselves in the technicalities of their trade. A course of ten lectures has been arranged to take place in the large hall of Cooper Union, beginning January 15th, to the expense of which President Seth Low, of Columbia College, has agreed to contribute $1,000, provided an admission is charged. Members of the society will be charged $2 for the whole course, and outsiders will have to pay twenty-five cents for each occasion. After the first lecture a free class will be formed to study electricity, under the supervision of W. H. Freedman, tutor in the class of electrical engineering in Columbia College. The following course of lectures has been arranged: "Batteries, Primary and Secondary," by C. O. Mailloux; "Direct Current Dynamos and Motors," by S. S. Wheeler; "Alternating Dynamos and Motors," by W. F. Stanley; "Electrical Measurements," by A. E. Kennelly; "Lighting," by Prof. F. B. Crocker; "Power," by Nikola Tesla; "Street Railways," by T.C. Martin; "Telegraphy," by M. Maver, Jr.; "Electrical Alarms," by M. Maver, Jr.; "Telephones," by J. J. Carty.

The officers of the society are: President, W J. O'Conner; vice president, William Ivory; secretary, C. H. Hines, treasurer, A. J. Kelley; librarian, F. E. Alexander.

In addition to the lighting contracts made two weeks ago the gas commission awarded the contract for lighting 189 lamps at 45 cents each per day and ten lamps at 50 cents each to the Thomson-Houston Electric Light company, December 22d.

The Automatic Phonograph Exhibition company, of this city, has gone into the hands of a receiver, Percy L. Klock, on the application of the trustees for a voluntary dissolution of the company. The liabilities are $36,000, with actual assets about $1,000. Cabinets and automatic devices nominally valued at $14,580 are in the hands of the sheriff, judgments for $13 219 having been entered against the company, one for $3,940 being in favor of Thomas A. Edison. The machines were operated by a nickel-in-the-slot device.

The New York & East River Gas company, which is to manufacture gas and electricity, has been incorporated. The directors are Michael Coleman, W. T. Barnard and Samuel B. Lawrence, of this city; J. B. Summerfield, of Brooklyn, and W. G. Houston, Jr., of Philadelphia. The capital stock is $700,000, and the business is to be carried on in New York city and Queens county. W. F. O.

Northwestern Notations.

MINNEAPOLIS, December 30.—The aldermen of Winona, Minn., have advertised for proposals on various combinations on street lighting. Bids are wanted for terms of 3, 5, 7 and 10 years as follows: First, for arc or incandescent lamps or both; second, with gas; third, with electricity and gas; fourth, with arc or incandescent lamps, the city to have the option of purchasing after two years the plant, the site to be furnished by the city; fifth, for an electric light plant, the city to provide site, building and power, to be completed by July 1, 1894. Proposals are to be made on a basis of 240 maximum and 150 minimum arc lights of 2,000 candle power each. A certified check for $1,000 is required. The bids will be opened February 11th, but the plan must be furnished by or submitted to the city engineer by February 1st.

The council of Albert Lea, Minn., has granted F. B. Fobes a franchise to put in the Strowger automatic telephone system. He can place poles and wires on all streets except one or two in the business center. Mr. Gulick of Minneapolis is superintending the construction, which is to proceed at once. There are fifty subscribers now in prospect.

The real estate board of Oshkosh, Wis., of which E E. Stevens is president, proposes to push the electric street railway project the coming year. The board includes many prominent men, and they seem to be thoroughly in earnest in the matter.

The court house of Aberdeen, S. D., will probably be lighted by electricity.

A large assortment of improvements is projected for the street railway company here. One change that will in all probability be made is the long-talked-of shift in the loop so that the interurban cars and others may swing up through the retail district along Sixth street. This is estimated to cost about $5,000. Various extensions and new lines are talked of, but are not likely to materialize. Among these are the two or three additional connecting links with St. Paul lines. There is also a scheme to extend the Washburn Park line so that it will touch Lake Harriet. Just at present the company has its hands full complying with the new law requiring vestibules for motormen. After various delays the work is well under way in the shops. There has been some talk of prosecution, but it will probably not amount to anything. The labor commissioner is keeping close watch on the company, however. The interurban cars are vestibuled and provided with Baker heaters. N L. P.

Cleveland, O.

CLEVELAND, O., December 30.—The consolidated street railway interests of Tiffin, O., have forwarded corporation papers to Columbus, asking for an increase of stock of from $300,000 to $400,000. The increase has been decided upon in order to construct a line from Tiffin to Melmore and thence to Sycamore, 15 miles southwest. From that point the road is to be extended to Upper Sandusky. A line is also projected between Melmore and Bucyrus.

The city has filed a petition in the Common Pleas Court asking an enforcement of the ordinance requiring that each train shall be manned with a motorman, a conductor and a trolleyman for each car, in addition to the motor car. The Cleveland Electric Railway company is made specific defendant. It is not believed that the ordinance will stand.

The Mansfield Street Car company, after experimenting with several vestibule devices, has at last adopted canvas fronts, in which are inserted two panes of glass. This is thought to be against the provisions of law, which define protection for the whole platform.

The values placed on the various telegraph and telephone companies to be taxed under the Nichols tax law have been determined as follows:

Western Union Telegraph company.....	$2,011,076.45
Postal Telephone Cable Company.....	149.373 00
City and Suburban Telegraph company....	482 465.00
Cleveland Telegraph company	380,444,00
Central Union Telephone company.....	429,717.00
Ohio Telegraph & Telephone company..	74,152 00
Central District & Printing Telegraph company.....	10,446.00
Miami Telegraph company.....	8,000.00
Total.....	$3,555,673 45

The Western Union Telegraph company has decided to fight the measure in behalf of all the telegraph companies, while the Cleveland Telephone company is paying under protest, so that if the law is not sustained the money will be refunded. B.

PERSONAL.

City Electrician John P. Barrett is in the east, visiting several of the large cities upon matters of business importance.

The marriage is announced of Miss Alice Maud White, daughter of Mr. and Mrs. Thomas H. White, of 1581 Euclid avenue, Cleveland, O., to William J. Hammer of New York, at the residence of the bride's parents, on January 3d.

Leslie W. Collins has resigned as western editor and manager of the *Electrical Engineer* to accept a more remunerative and advantageous position with the *Electrical World*. In securing his services Mr. Johnston, the proprietor of the *Electrical World*, is to be congratulated, as he has added to his staff an enterprising and wide-awake representative.

ELECTRIC LIGHTING.

Preparations are being made in Etna, Pa., for the erection of an electric plant for commercial and lighting purposes.

A new and complete electric lighting system is being placed in the Camp Manufacturing company's plant at Graham, Tex.

The Wisconsin towns of Bangor, Salem and Onalaska are to be lighted by electricity generated by water power at Meshonoc.

The Pecatonica, Ill., electric light plant, which has been closed for over a year, has been purchased by Samuel Corwin, of Rockford, Ill. He will build a new power house and start up again.

The county commissioners at Indianapolis, Ind., have decided to install an electric light plant for the court house and county jail. The board has advertised for bids which will be received and opened January 15, 1894.

The proprietors of the Atlantic City, N. J., Gas & Water company have determined to put in an incandescent electric lighting plant. The electric company now doing business there operates a plant of the Edison type.

The expected fight over the location of the new electric light plant on a site on West Polk street, near Ashland avenue, Chicago, did not develop in the last meeting of the committee on streets and alleys west. An effort is being made, it is understood, to secure another site.

An ordinance has been passed by the council of Reading, O., compelling the Pittsburg, Cincinnati, Chicago & St. Louis Railway company to light its tracks and several streets in the village by arc lamps, to burn under the same conditions which control the other lights in the village.

Messrs. J. H. Holmes & Co., of Newcastle, England, have just completed the lighting throughout by electricity of James Gordon Bennett's steam yacht Namouna, the lights being arranged for decorative as well as useful purposes. A Belliss compound engine is used, coupled direct to a Castle dynamo, and the plant includes a battery of accumulators. The whole of the lighting of the yacht is by electricity. A number of novelties have been introduced, including the playing of a piano by means of an electric motor. The entire work is said to be a great success.

A correspondent writes in the *Western Mail* that "The penny-in-the-slot electric lamps have come into use on the London underground railways this week. Trusting to memory, I will say it is two years since the first experimental lamps were put on a few trains and described by me. Since then arrangements have been made to fit the lamps to all the trains and the work is now complete. There are four lamps in each compartment. If you want to read, and the ordinary light is insufficient (that is a dead certainty), you put a penny in the slot and obtain an electric light, which lasts you half an hour. If you want more you have to put in another penny. The lamps are conveniently placed at the back of the seat so as to throw the light on the book or paper. They were in immense demand at the outset. Everyone wanted a pennyworth of electric light, and I believe people used the trains on purpose to try the lamps."

ELECTRIC RAILWAYS.

Edward Morton, of New York, has applied to the city council of Fort Howard, Wis., for a franchise for an electric railroad.

The council of Waukegan has been asked for an electric railway franchise. It is also proposed to establish an electric light plant there.

Engineers and contractors of the Ontario & Western railroad are looking over the ground for an electric railway from Liberty, N. Y., to White Lake.

A line is proposed to be built by American enterprise from Tokio to Yokohama, Japan, 30 miles long, connecting with branch lines at both ends in these cities.

An attachment suit by the General Electric company against the City Electric Street Railway company, Little Rock, Ark., was begun Dec. 16th, in the Pulaski circuit court. The suit involves the legality of claims aggregating nearly $300,000 against the railway company, which is now in the hands of a receiver.

Action was begun at St. Paul, Minn., December 22d, to compel the Twin City Rapid Transit company to erect vestibules on its cars for the protection of its grimpen and motormen from the snow and wind. Upon complaint of James L. Morrow, president of the St. Paul trade and labor assembly, a warrant of arrest was issued against General Superintendent Hoskins of the street railway company. A law was passed by the legislature of 1893 requiring that vestibules be placed upon all winter cars. No attention, however, was paid to the law by the street railway company, it is claimed, and the arrest of Mr. Hoskin was the result.

In connection with the plan of the West End railroad for the running of a line of electric cars over Beacon Hill, through Mt. Vernon, Temple and Staniford streets, Boston, an objection has been raised that the state house commissioners will object to the cars going through that portion of the way that extends along the side of the state house property. It has been suggested, as an improvement to the West End plan, and at the same time afford an electric line over the hill, that a curve be made from the head of Park street around to Bowdoin street and thence back to the line of Temple street at Derne street, so as to leave the state house grounds, which includes Mt. Vernon street and Temple street, from Beacon to Derne street, intact.

ELECTRIC MINING.

An important piece of work was inaugurated recently in the starting of an electrical pumping plant at the co-operative colliery at Plattsburg, near Newcastle, Australia. Steam has been used hitherto, but the pipes used in conveying the steam from the engine house at the mouth of the tunnel when heated have the effect of softening and disintegrating the roof, and frequent heavy falls of shale, which forms the covering, have resulted, suspending the work of pumping and causing much expense. The plant consists of a Crompton series wound dynamo, worked by a 4 horse power Tangye engine located at the pit mouth, and a similar series-wound motor and Tangye pump at the pumping station in the mine, half a mile from the pit mouth. Power is transmitted by two 7-16 Callender cables. The pump at the trial gave a delivery of 4,000 gallons per hour. Upon the success of this plant, no doubt, depends the placing of many similar orders.

TELEGRAPH.

In the case of the Great Western Telegraph company against Bureau county, Ill., subscribers to stock, to compel them to pay, Judge Stipp has decided that the subscribers were not liable because of failure on the part of the company to perform its part of the contract. The subscribers held that the claim of the company was not good for the reason that if they were compelled to pay it would in a certain sense be obtaining money under false pretenses, and hence they have persistently fought the company for a number of years.

It was announced recently that the three most important cable manufacturing companies in France had entered into a combination. These companies were the Société Générale des Téléphones, which owns a sub-marine cable manufactory of Calais, and the two companies of Messrs. Rattier and Menier. The joint companies now bear the name of the Société Industrielle des Téléphones, and has a capital stock of $3,120,000. It is evident from the following telegraph from Paris that the French government intends as far as it can, to foster the cable industry in France, and that it wishes to be no longer dependent on English labor and English capital for means of communicetion with its colonies: "A commission has been instituted by the Posts and Telegraphs Department to study the question of the international telegraphic communications of France. This commission, which comprises several senators and deputies, delegates from the ministers of foreign affairs, war, the marine, and commerce and industry, as well as superior functionaries of the colonial department and of the posts and telegraphs administration, met recently for the first time. The work of the commission consists in drawing up the programme of all the telegraphic communications, the establishment of which is deemed necessary in the interest of France, the estimation of the cost of the various lines, and the order in which the works should be carried out. After an exchange of views, in the course of which it was declared that it is now more imperiously necessary than ever to organize a system of French submarine telegraphic cables, the commission charged a sub-commission to elaborate a comprehensive plan, and to prepare certain projects, the carrying out of which was regarded as particularly urgent."

TELEPHONE.

During the recent fetes at Blenheim Palace, in England, on the occasion of the celebration of the 21st birthday of the Duke of Marlborough, no less than 50 telephones, connected with one central exchange room, were scattered throughout the palace.

That little difference of opinion which recently sprang up between the Cambridge, Mass., city council and the New England Telephone & Telegraph company, the result of which was the discontinuance of free telephone service for the city government, has not terminated as the city fathers hoped it might. The telephone company is inexorable. It refuses to continue the courtesy of free service as heretofore, consequently the city government is obliged to pay at the rate of about $1,000 per annum for talking over telephone lines when transacting city business.

The tallest building in Stockholm, Sweden, is the huge iron lattice-work tower of the central telephone exchange. Myriads of wires run from it, darkening the air. Every one in Sweden uses the telephone, and uses it, moreover, very much. A writer who has been sojourning in a boarding house in the Swedish capital declares that the most significant feature in the routine of the establishment was its never-ending telephonic babble. When he awoke in the morning it was to hear the jingle of the bells in the corridor outside his room end the iteration of the word "Hvad?" (What?) One morning he asked the landlord, who was at the instrument, what it all meant. His wife, he replied, was buying some stores and was telling him about them and their prices, and he on his part was shouting back to tell her in which particulars the prices seemed reasonable and in which unreasonable. Another day the writer's landlord went for a sledge drive into the country. When he had been gone two hours the telephone began to be annoying and his wife staid at it at a long time, crying, "Oh!" and "Ah!" and "Yes" and "No." "It is monsieur," explained a young lady who happened to be standing by. "He is resting for dinner at —— and is informing madame about the incidents of his excursion and the details of the meal that is being prepared for him."

LEGAL DECISIONS.

A telegraph operator sued the Bridge & Terminal Railroad company at Martins Ferry, O., claiming $523 for overtime, having worked from fourteen to eighteen hours a day, while the Ohio law makes ten hours a day's work, and a jury in the Circuit Court at that place has awarded him the full amount demanded. It appears that the employing company was neglectful in regard to its agreement with employes, as the fact that ten hours make a legal day would not prevent anybody from contracting to work any number of hours at a given salary, if he chose.

In the action of the Western Union Telegraph company against Bullard, in the Supreme Court of Vermont, to recover the penalty prescribed by statute for wilfully interfering with a telegraph line, which provides that persons associated together for the purpose of erecting a line of telegraph may maintain the necessary fixtures in and along any highway, but that the same shall be done so as not to interfere with the public convenience, the declaration sufficiently shows that its telegraph line was maintained pursuant to such statute, where it alleges that it erected and maintained the line upon and over a certain highway in such manner as in no way interferes with the public convenience.

It was held by the court in the case of the Edison Electric company against the Mt. Morris Electric Light company, that organizations organized during the pendency of the test suit involving the validity of the Edison patent for incandescent electric lamps, whose sole business is the furnishing of electric light to others and who use infringing lamps for the purpose of competing in that business with the license of the patentee, are to be regarded as manufacturers rather than mere users, who are entitled to protection because they have supplied themselves with electric lighting plants before the decisions of the lower courts sustaining the patent, and at a time when judicial decisions in foreign countries were in conflict.

Special Judge James C. Wright has filed his decision in the Circuit Court of Ohio in the case of the Covington Electric Light company against the Suburban Electric Light company. The plaintiff, the Covington Electric Light company, seeks to recover from the defendant on its contract and garnish certain money in the hands of the city of Newport. The defendant filed a pleading making the city a co-defendant in the suit. The demurrer made by the city is sustained in that it does not state facts sufficient to support a cause of action. Therefore, the demurrer is sustained, and the defendant has leave to amend,

and the motion of the defendant for a judgment against the city is overruled. The defendant, the Suburban Electric Light company, discontinues its counter-claim against the city without prejudice.

In the case of Blashfield against the Empire State Telegraph & Telephone company, in the Supreme Court of New York, it was decided that the construction of a telephone line by erecting poles and stringing wires thereon in a country highway constitutes an additional burden on the fee of adjoining lands extending to its center, not contemplated in the original dedication, for which the owner is entitled to compensation. The occupation of a highway by such poles is not one of the ordinary and legitimate uses for which the highway was established, and it is the impostion of an additional burden on and taking of the property of the owner of the fee, which enables him to maintain an action to compel the removal of the poles, and to recover possession of the premises occupied thereby, with damages, where such occupancy is without his consent and without compensation having been previously made him therefor.

MISCELLANEOUS.

The city statistician of Chicago reports there are 150 establishments for "electric lights, works and materials" in the city.

A 70-inch pulley in the works of the Jamestown, O., Electric Light & Power company, broke a short time ago and caused a loss of between $2,000 and $3,000.

Natural gas accumulated under the floor of the Elwood, Ind., Electric Light & Street Car company's dynamo room exploded recently and ruined the plant.

There is a strong movement in Lynn, Mass., in favor of compelling companies to place electric wires underground, and the city council has passed a resolution to that effect.

The contract for supplying the structural steel to be used in the construction of the new plant of the Westinghouse Electric & Manufacturing company has been awarded to the Carnegie Steel company, Pittsburg.

The Eddy Electric Manufacturing company, of Windsor, Conn., has perfected a motor for firing a Gatling gun. The motor is in the breech of the gun, and is protected by a metal case. By the use of the motor, it is claimed, 3,000 shots per minute can be fired.

Preparations are being made at Chillicothe, O., for a trial of an electric canal boat. A short time ago the superintendent of the Chillicothe Electric Street Railway & Lighting company made proposals on the subject. Representatives visited the recent test at Rochester, N. Y., and arrangements have been made for furnishing current for a 25 horse power motor.

Good progress is being made with the establishment of the central station at Manilla in the Philippine Islands. A company with a capital stock of $500,000 has been formed to establish and operate the station. The plant will be of American manufacture, the motive power being supplied by six compound engines, each of 200 horse power, constructed by the Buckeye Engine company, of Salem, O.

The General Electric company has absorbed the Municipal Electric company, of St. Louis, and announces that it has assumed all the latter company's contracts, including the contract with the city for street lighting. There is some dissatisfaction with the municipal company and its successor, it is said, and a movement, backed by capitalists, is on foot to build and operate a consumers' plant.

TRADE NEWS.

Walter C. McKinlock, secretary of the Metropolitan Electric company, Chicago, has just returned from a successful business trip and reports the outlook for the new company as very promising.

H. Ward Leonard, of Leonard & Co., electrical engineers, of New York, reports that his business for the past year has been good, with indications of continued progress this year. This concern has now a number of contracts for new work which will keep it busy for several months and is also engaged with estimates on a large amount of prospective work.

Huebel & Manger, makers of electrical and brass goods, 286-290 Graham street, Brooklyn, N. Y., have issued an illustrated catalogue and price list of bells, push-buttons and electrical goods, which is complete and convenient in all its details. The designs of push buttons, bells and gongs, as illustrated in this catalogue, are pleasing, and the appearance of the entire book indicates that it has been compiled with care and consideration.

The "Mac" tape, which is handled by the Metropolitan Electric company, Chicago, and which is of particular value for armature and field magnet wrapping, possesses many merits which are worthy of consideration. It uas superior insulating qualities and is made to withstand the most severe of climatic changes. It sticks to the wire. It will not oxidize the wire, and its adhesive qualitles are such that it is practically indestructible and consequently does not appreciably deteriorate with age. This company is also handling the Blair adjustable lamp hanger.

F. R. Chinnock, who for the last two years has been the general eastern agent of the Ball Engine company of Erie, Pa., has resigned his position with that company and will again enter the electrical field, with which industry he was long and successfully identified as agent of the Edison General Electric company for eight years. During the past ew months Mr. Chinnock has made the following sales of Ball engines: J. M. Ives Co., Danbury, Conn., one engine; Ridgewood Electric Light & Power company, Ridgewood, N. J., one boiler; Brooklyn Navy Yard, one 100 horse power heavy duty engine for running sawmill; General Electric company, for Hot Springs, Va , two engines and one boiler (increase); Imperial Hotel, New York city, one 150 horse power engine; Schwarzenbach, Huber & Co , Union Hill, N. J., one boiler; for export to Cuba, three engines; "Big Four" Railroad company, Indianapolis, Ind., complete steam plant including two engines and three boilers; John Goode Rope, Cordage & Machine company, Ravenswood, L. I., one 600 horse power cross-compound engine.

The Electric Appliance company, Chicago, reports a particularly merry Christmas, principally on account of the fact that it was able to get its entire trade supplied with copies of the latest edition of its catalogue, and for the last week it has been in receipt of numerous congratulatory letters complimenting it upon its completeness, attractive appearance and intelligent arrangement. The first principal division of the contents of the book is incandescent electric light supplies. Arc light and station supplies form the next principal division, with an extensive line of goods for station use and arc lighting, including carbons, globes, spark arresters and other specialties. A complete and well illustrated list of construction and general tools follows, which is in turn followed by a very carefully selected line of construction material, including extensive lists of Paranite rubber-covered and O. K. weatherproof wire, two leading specialties of this company. Immediately following the lists of wires of various kinds is a number of valuable electric light and motor wiring tables. Interior conduit material next receives its share of attention. Testing instruments come next, with a large line of Whitney instruments. A full line of Meston motors closes the electric light department of the catalogue, the remaining one hundred pages being devoted to an attractive arrangement of electrical house goods, telephone and telegraph supplies and fire alarm and district telegraph material, making a catalogue of about 350 6 by 9 pages. Every article has its own trade number and also a telegraph code word so that the possibility of mistakes in placing orders either by mail or wire is reduced to a minimum.

BUSINESS.

"Working full time and full capacity and behind in deliveries," is the gtatifying report furnished by the Clayton Air Compressor works, of 43 Dey street, New York, as to their shops in Brooklyn. In the prevailing business depression this speaks volumes for the excellence of the compressors built by this company. The company has recently aken out several valuable patents on a new triple compound high pressure air or gas compressor, used largely by manufacturers of carbonic acid gas.

Goodhue & Lincoln, 1564 Monadnock block, Chicago, although but lately organized as a firm, have proved remarkably vigorous in making their influence felt in the electrical field. They report that, notwithstanding the general depression of business, they have secured a number of satisfactory orders including, among others, contracts for 2,500 lights in transformers. This firm intends to handle only the highest grade of electrical material, and states that it is in the business with every prospect of success.

Stanley Green, western representative of the Fuel Economizer company, of Matewan, N. Y., has recently closed in the West a number of good contracts for the installation of his economizer. The most recent sale was to the Chicago City Railway company of 9 000 horse power of economizers for the Ewing avenue station. Mr. Green has also placed a 500 horse power economizer equipment with the Indianapolis Brewing company of Indianapolis, Ind., 500 horse power with the Terre Haute Street Railway company, 150 horse power with the Lake Cities railway, and 1 200 horse power in Syracuse, N. Y. Such a line of contracts as the above speaks for itself as to the merits of the Fuel Economizer company's apparatus.

The Electro-chemical & Specialty company of New York city has recently purchased the exclusive right to manufacture and sell the well known Atlantic electric motor, for which it was last year the selling agent and for which it received more than five thousand orders. Owing to the failure of the manufacturers to supply them in large quantities on account of lack of factory capacity, the connection with them has been severed, and the Electro-chemical & Specialty company is desirious to complete arrangements with some concern having proper facilities to fill the orders left over and to supply those that are to come. The company has letters from various supply dealers stating that the motor is far ahead of any other in the market.

ELECTRICAL PATENTS.

Issued December 19, 1893.

510,889. Temperature Regulator for Electric Heaters. Albert M. Butz, Oak Park, Ill.

The heater comprises a plurality of resistances connected together and adapted to unit heat when current is passed through them. A thermostatic device is provided which successively cuts out or in the resistances as the temperature approaches the desired degree.

510,892. Brush Holder. John R. Coffman, Detroit, Mich.

510,898. Electrical Connector. Frank G. Curtis, New York, N. Y.

510,899. Method of Adjusting the Joints of Carbon Electrodes. Elisha B. Cutten, New York, N. Y.

510,900. Apparatus for Electrolytically Producing Soda and Chlorine. Elisha B. Cutten, New York, N. Y.

510,901. Electrode for Voltaic Cells. Elisha B. Cutten, New York, N. Y.

510,902. Electrode for Voltaic Cells. Elisha B. Cutten, New York, N. Y.

510,921. Electric Pump. Frank W. Merritt, Duluth, Minn.

510,929. System of Telegraphy. Josiah A. Parker, St. Louis, Mo., and Leland L. Summers, Chicago, Ill.

510,932. Electric Elevator. Frank A. Perret, Brooklyn, N. Y.

510,947. Electric Locomotive. Charles F. Winkler, Troy, N. Y.

The two axles of the truck each carry an armature, the two armatures being included in series in a magnetic circuit excited by field coils lying between the two axles, the field pieces being made with a central joint and flexibly connected together.

510,952. Brush Holder for Dynamo-electric Machines. Frank E. Averill, Syracuse, N. Y.

511,005. Telegraphic Relay. Edward Weston, Newark, N. J.

The relay comprises a magnetic field and a pivoted coil of wire, to which is attached the contact arm that serves to make and break the electric circuit controlled by the relay. When current passes through the coil it tends to set itself transversely to the lines of force of the magnetic field, thus rotating upon its axis and closing the circuit.

511,017. Electric Railway Switch and Crossing. William W. Hendrix, Bowling Green, Ky.

511,018. Electric Railway Trolley. William W. Hendrix, Bowling Green, Ky.

511,019. Electric Railway Trolley. William W. Hendrix, Bowling Green, Ky.

511,049. Electric Arc Lamp. August Hormel and George S. Junginger, New York, N. Y.

511,081. Telautograph. Rudolph M. Hunter, Philadelphia, Pa.

Positive and negative currents of variable potential are generated and transmitted over the line and energize electromagnetic devices located at the receiving station, which electromagnetic devices actuate and control the movement of the tracing point at the receiving station. The positive and negative currents of varying potential are induced at the transmitting station by the act of writing with a tracing point.

511,118. Magneto Telephone. James A. Brown, Moline, Ill.

The undulating currents are produced by varying the reluctance of a magnetic circuit by the movement of the diaphragm. The coil surrounds a soft iron core which rests by one end in contact with the diaphragm, so that a longitudinal movement may be imparted thereto, while the opposite end yieldingly bears against the pole of a permanent magnet. As the diaphragm vibrates the soft iron core presses against the permanent magnet with a varying force, thus producing undulations of magnetic field, threading the coil and inducing in the coil an undulatory current.

511,131. Electric Railway Signal. José Ortega y Espinosa, Mexico, Mex.

511,157. Hand Regulator for Electric Motors. William D. Packard, Warren, O.

511,159. Primary Electric Battery. Edward Poppowitsch, Brooklyn, N. Y.

511,163. Signal for Cable Railways. Joseph Sachs, New York, N. Y.

511,167. Label Holder. John H. Shaffer and Emil Horovsky, Allegheny, Pa.

511 172. Telegraphic Transmitter. Mary E. Stinde, Red Bud, Ill.

511,173. Electrically Operated Railway Switch. Charles A. Stone, Newton, and Edwin S. Webster, Boston, Mass.

511,187. Electric Regulating Switch. Edward A. Barber, Watertown, N. Y.

511,188. Electric Signaling Device for Hose. George L. Barnard, Milwaukee, Wis.

511,196. Electric Motor. Oliver F. Conklin, Dayton, O.

511,214. Brush Holder for Electric Motors. James J. Robison and Fred B. Perkins, Toledo, O.

511,229. Electric Lamp. Albert Zobel, Munich, Germany.

511,240. Electric Switch. Jesse L. Hinds, Syracuse, N. Y.

511,244. Telegraph Relay. Frank P. Medina, San Francisco, Cal.

The electromagnets acting on the relay armature are constructed so as to have small self-induction, and are surrounded by electro-magnetic shunt coils of relatively great self-induction, so that there will be an added magnetic effect at the beginning of a signal and a more rapid cessation of the magnetism at the end.

511,245. Thermo-electric Element. Max Mestern, Turin Italy.

511,254. Closed Conduit Electric Railway. William S. Smith, Berkeley, Cal.

511,276. Two Station Telephone Circuit. Frank A Pickernell, Newark, N. J.

Two subscribers' station apparatus are connected with a single metallic circuit line extending to the central office. One limb of the circuit is in contact with the call devices of one of the subscribers, the other limb being open at this station, while the call devices of the second subscriber are connected with the second limb, the first limb being normally open at this station. The two subscribers are thus provided with separate calling circuits, the return in each case being through ground.

511,286. Resistance Box. Adelbert O. Benecke, Newark, N. J.

Western Electrician.

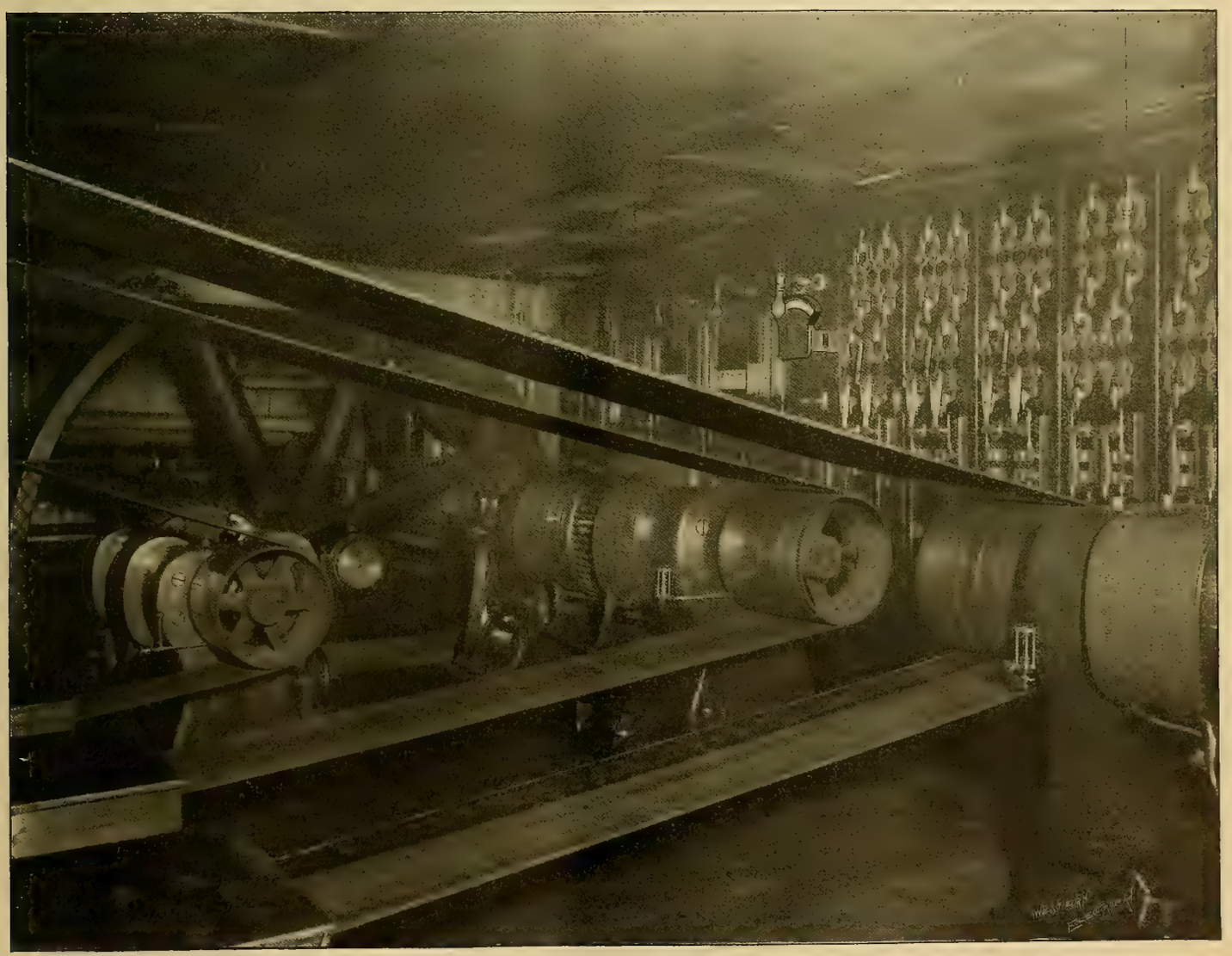
EVERY SATURDAY.

Vol. XIV. CHICAGO, JANUARY 13, 1894. No. 2

Electrical Plant in the Illinois Central Railroad Depot at Chicago.

One of the most pleasing and extensive decorative electric lighting effects in Chicago may be seen in the main waiting room in the new depot of the Illinois Central railroad at Park Row and Twelfth street. The ceiling of the room is arched and incandescent lamps are arranged in rows from one side of the room to the other, much after the manner of the lights in the Auditorium theater ceiling, an arrangement which beautifies the elegant appearance of the highly polished stone finish of the room and its stained glass windows. Some idea of the brilliant effect produced here at night may be gathered from the fact that the illumination is produced by 1,742 16 candle-power lamps. In the sub-ways for passengers leading from the trains and under the tracks a great number of incandescent lamps are also used, arranged upon the sides of the passage ways. The offices in the building are also lighted by this method, and in all there are 4,200 incandescent lamps. In addition to these lights, scattered about the train sheds and in other exposed places are 92 arc lights run upon incandescent circuits. The lamps are of the types manufactured by the General Incandescent Arc Light company and the Electric Construction & Supply company and use ⅝ inch single carbons.

Not less interesting is the station where the current is generated for supplying these lamps. It is located in the basement, and is remarkable for the amount of machinery which has been installed in a limited space. The room is about 100 feet square and contains two Hamilton-Corliss engines, of 250 horse power capacity each, belted to either end of a 60-foot line shaft. Three steel tubular boilers, five by eighteen feet, with Eddy furnaces, and eight pumps of various sizes, ranging from the largest make of elevator pumps to a small ordinary boiler feed pump, comprise the boiler-room equipment. The electrical portion of the plant consists of two Brush 100 kilowatt and one Brush 45 kilowatt direct current dynamos, each wound for 125 volts, and belted to shafting controlled by clutches. The dynamos, switchboard and the flywheel of one of the engines are shown in the illustration presented upon this page. The switchboard, which is of the Brush type, is made of black enameled slate and controls 10 circuits. Upon it are contained, among other instruments, four ammeters, three rheostats, a voltmeter, ten double pole switches equipped with safety devices, and three dynamo switches. By the side of this board, but not shown in the illustration, is another small switchboard controlling the electrical automatic heating system of the building which is said to be giving excellent satisfaction. The arrangement of the machinery in the limited space available is excellent and affords sufficient room for working. Much interest has been manifested in this plant owing to the number of low tension arcs, and its operation has been watched with much attention. The building throughout is wired upon the two-wire system and 114 volt incandescent lamps are used. The entire capacity of the plant is 5,120 lights but it has never been necessary to run it to its full capacity. The arc lamps are run upon separate circuits and in fact the entire building is wired in this manner, a separate circuit running to the train sheds, one to the subways, etc. The Chicago Edison company attended to the wiring details and interior conduit is used exclusively. One of the features in this installation is the use of the new Cutter flush switch, which is the same in appearance as the ordinary push-button switch, the block being flush with the wall and the operating mechanism concealed from view and buried in the wall. The building itself is elegantly appointed and in keeping with the excellence of the lighting scheme and plant.



ELECTRICAL PLANT IN THE ILLINOIS CENTRAL RAILWAY DEPOT AT CHICAGO.

National Electric Light Association.

At the forthcoming meeting of the National Electric Light association the following topics will be discussed:

What is the most economical size of arc dynamos?
Arc lights on incandescent circuits.
How to rate arc lamps.
Meters versus flat rates.
Electrolytic effects of return currents.
How to wire buildings.
Commercial alternating motor.
Storage batteries.

Electricity in a Japanese Mine.

S. Fujioka, chief engineer of the Ashio copper mine, visited Chicago a short time ago on his way to Europe to study various electrolytic processes for the refining of copper. He will probably remain in Europe for about a year. From Mr. Fujioka it was learned that the Ashio copper mine is situated about 3,000 feet above sea level, the smelting works and central office being a valley close to the mine. The mine is in the interior, north of Tokyo. It is the richest copper mine of Japan. Its production of crude copper in 1877 amounted to only 56 tons, but has gradually been increased, until the output was 6,099 tons in 1891. New smelting works employing a specific Japanese method (the improved "Mabuki" plan), of a capacity of 6,000 tons of ingots per year, have just been completed.

The mine is fortunately situated in regard to fuel, as any quantity of wood or charcoal can be obtained at reasonable rates from a distance of from 6½ to 18 miles. The fuel consumed in 1892 amounted to 18,000 tons of charcoal and 35,900 tons of wood, costing 208,900 yen, or $146,230. About 1,600 horse power is now used in the mine divided as follows: Mining, 760 horse power; dressing, 320 horse power; metallurgy, 250 horse power; workshop, haulage, electric light, 270 horse power. The company is also utilizing water power and has already installed turbines of a total of 338 horse power. The dam is located three miles above the electric generating station. A wooden flume three feet wide and two feet deep running along the mountain side with a fall of three feet per 1,000, furnishes 2,700 cubic feet of water under a head of 100 feet. An old-fashioned turbine of German manufacture was formerly used, but owing to its complicated construction and low efficiency, it was lately replaced by five Pelton wheels, each four feet in diameter running at 160 revolutions per minute and yielding 100 horse power. Each wheel drives a Siemens dynamo of 90 horse power. The current is then conducted a distance of four miles on five copper mines, each 12 milimeters in diameter at a loss of 20 per cent. to motors driving various machinery. The power is distributed as follows:

Drainage	120	Electrical	Horse	Power.
Winding engines	50	"	"	"
Rock drills	90	"	"	"
Blowing engines	100	"	"	"
Total	360	"	"	"

As the five dynamos deliver a total of 450 electrical horse power at their brushes 20 per cent. must be deducted for loss in the wires, which leaves 360 electrical horse power for delivery at the motor brushes.

There are six additional turbines under construction—one of 100 horse power at the Otsudo level, four of 120 horse power for the wire rope tramway, and one of 80 horse power for the metallurgy and electric light. When these are completed the water power will amount to 1,000 horse power or about 70 per cent. of the total power required for the mine.

There is now in operation a dynamo of 90 amperes and 60 volts capacity furnishing incandescent and arc lamps in various parts of the mine. Upon completion of the hydraulic power two more dynamos, each of a capacity of 90 amperes at 225 volts will be used. Telephone wires connects the different parts of the mine with an exchange in the central office of the mining company, from which 40 miles of wire run to the branch office in Nikko.

Assignment of the Railway Equipment Company.

On January 3d the Railway Equipment company, of Chicago, made an assignment to George O. Fairbanks. This step is ascribed to the prevailing financial depression, particularly the difficulty in making collections. The company had several heavy obligations to meet about the first of the year, and was unable, it is said, to collect sufficient money to enable it to do so. President W. R. Mason takes a hopeful view of the situation, however, and estimates the assets of the company at $40,000, with liabilities of $30,000. He expects to issue a formal statement in a few days, and hopes that a few weeks' indulgence will put the company on its feet again. The Railway Equipment company is well known in the West as a dealer in electric railway supplies. In a measure it is the successor of the old Electric Merchandise company, which was very successful. The activity of the company, however, has been considerably hampered by a lack of harmony in the internal management.

The Fremont, O., council has granted an electric railway franchise, and work has been commenced.

Electrical Equipment of the Ashland Block, Chicago.

Among the many isolated plants in the great office buildings of Chicago, it would be difficult to find one better kept or presenting a neater appearance than that in the basement of the sixteen-story Ashland block on the corner of Clark and Randolph streets, Chicago. All the mechanical and electrical contractors put in their best work, with the result that the whole equipment is a model of its kind and has many visitors. This gratifying state of affairs is largely due to the energy and skill of F. J. Saxe, the assistant superintendent and chief engineer of the building, who unites an ambition to excel with a thorough practical knowledge of the subject in hand. Mr. Saxe has eight assistants, and the plant is never allowed to deteriorate, while improvements are constantly being made.

The plant comprises the operating mechanism for lighting and heating the building and the elevators. Four return tubular boilers, furnished by Baker, Smith & Co., of Chicago, are used, two being operated at a time and two being held in reserve. These boilers are rated at 125 horse power each and are fired by natural gas. Formerly coal was burned, but the delivery of this fuel was found to be such an annoyance that the gas was substituted, although the cost of the latter is $75 to $100 per month greater. The exhaust steam is used for heating in winter, and in summer is allowed to escape into the stack, which extends above the roof of the building, 235 feet above the grate bars. An Excelsior feed water heater of 500 horse power capacity is used, while the boiler feed pump is of the Knowles type, built to Mr. Saxe's order by Cook & Chick of Chicago. This pump has cylinder dimensions of 12 by 7 by 10 inches, while a Worthington pump, 9 by 5¼ by 10 inches, serves for the house service. These pumps are so connected that one can take the place of the other in case of an accident. There are three large Worthington compound duplex pumps for the eight Crane hydraulic elevators, with dimensions of 16 by 25 by 15 by 15 inches. Two Westinghouse air compressors of the locomotive type are operated for the ejection of sewage, while a smaller air compressor is used in connection with the Johnson system for automatic temperature regulation in the various offices by the use of thermostats electrically connected to the valves on the radiators, which are controlled by electromagnets and operated by the compressed air. A prominent feature of the mechanical equipment is a fine marble gauge-board in which are mounted the gauges showing the boiler steam pressure, elevator water pressure, house tank water pressure, steam heating pressure, city water pressure and a clock.

Three Ideal engines of 100 horse power each provide the power for electric lighting. They are belted directly to three Western Electric 1,000 light dynamos, as shown in Fig. 1. These dynamos are over-compounded and have a capacity of 550 amperes each at 110 volts, running at 725 revolutions per minute. They are of the latest type manufactured by this company, and are equipped with the new multiple wound armature and self-oiling ball and socket bearings. They are mounted on insulating adjustable base frames which permit of the belts being tightened while the machines are in operation. The commutator and brushes are larger than ordinarily used for machines of this capacity, thereby reducing the heat. It is said that the rise in temperature of these machines is but 80 degree above that of the surrounding atmosphere when they are operated 12 hours at full load. The dynamos are connected to the switchboard by Patterson cable run underground, a short equalizer connecting the machines. At the switchboard specially designed switches are provided for operating them either singly or in multiple.

The switchboard, Fig. 2, consists of four red Tennessee marble panels, set in an ornamental antique oak frame. This board is equipped with a main dynamo switch for each dynamo, a switch for each feeder, leaving the board, an ammeter for each dynamo, a voltmeter with compound switch for indicating the voltage at different points of the wiring system, a lamp ground detector and one main ammeter for measuring the total output of any or all of the dynamos that may be in use. On the back of the board are placed the bus bars, to which are connected each of the dynamos through the ammeter indicating the current on that machine. Where the leads from the dynamos are connected to the bus bars they are provided with fuses for the protection of each dynamo. The rheostats are also mounted on the back of the board, and an extension of the handle is placed on the front with graduations which indicate the number of segments of the rheostat that are cut in or out. The instruments in use on this switchboard are of the Western Electric and Weston central station type.

The wiring system of the building is divided into two sections, north and south. Each section has a pair of risers of No. 00 wire, extending from the basement to the top floor. These risers are attached to wires at each floor to lead to the cut-out cabinets from which all branch wires run for supplying lights in the respective sides of the building. The risers are fed by feeders from the bus bars on the switchboard at three different points—on the third, ninth and twelfth floors. At each of these floors there is also a pair of equalizers run across the building from north to the south section, connecting the risers together, the plan being to balance up the system of wiring by making the lost volts absolutely the same in all parts of the building, regardless of how many lights there may be on either side. Where these equalizers are connected to the risers they are provided with fuses proportioned for the safe carrying capacity of the wire. By this system of wiring the risers are intended to carry the current but one floor each way, at which point they will meet the current from the distributing point above or below. The feeders at the different points in the building are figured for the same loss; that is, the size of the feeders for the top floor are proportioned to the distances as compared with those of the third floor. The cut-outs for these mains and feeders, which are placed in the vent shaft of the elevators, are specially designed for this part of the work and have a carrying capacity of 50 per cent. above that of the size of wires which they connect. These mains and feeders are run on glass insulators throughout. All cut-outs are mounted on slate bases, making the entire installation free from danger of grounds and reducing the liability of fire to a minimum. The entire electrical equipment was furnished by the Western Electric company.

About 2,900 Edison and Sunbeam lamps are connected with the switchboard while several ventilating fan motors are also operated in various parts of the building. The heaviest load is between 5 and 6 P. M., when it ranges from

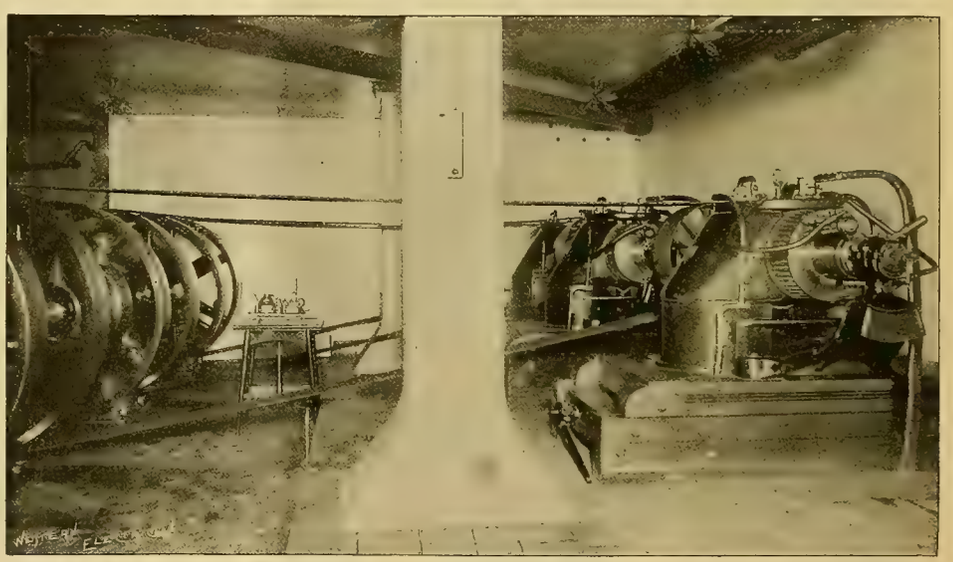


FIG. 1. ELECTRICAL EQUIPMENT OF THE ASHLAND BLOCK, CHICAGO.

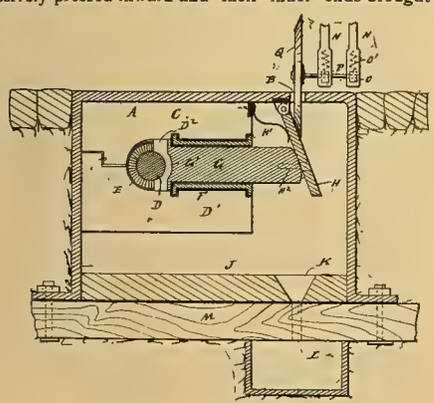
850 to 900 amperes. The adjoining Olympic theater is also lighted from this plant.

Storage batteries are used for the Johnson automatic temperature controlling circuits and are charged from the dynamos. Two switchboards in Superintendent Saxe's private office serve to detect the location of grounds on the Johnson circuits, and a Weston voltmeter enables the superintendent to ascertain the working potential of the lighting system at all times without stepping out of his office. The plant is well equipped with supplies for making repairs, either electrical or mechanical, and every detail is systematized.

New Form of Trolley Conduit.

Of the invention of conduits for under-running trolleys for electric railways there is no end. Many have undertaken to solve the two-fold problem of preventing contact with the conductor except at the passing of a car and of securing efficient insulation. One of the latest proposals is that of Henry D. Oler, of Patterson, N. J., who has patented a conduit of the form shown in transverse section by the accompanying cut. The conduit *A* is provided with a longitudinal slot *B* in its top. To the under side of the top plate a block of wood *C* is fastened, and to the under side of this another block of wood D^1 is held in a suitable manner. Between these blocks the conductor *D* is held, one side of the conductor being naked and the remaining half being provided with an insulating covering *E*. The blocks *C* and *D'* extend the entire length of the conductor, and from the exposed side of the conduit an opening or groove D^2 extends throughout the entire length of the conduit through the blocks to the right hand side. In this opening a series of guide boxes *F* are held, which are provided with an insulating covering and are provided with flanges at the inner and outer ends, and in these guide-boxes sliding blocks *G* are arranged, which have their inner ends recessed, as at G^1 to fit against the conductor *D*. Plates *H* are hinged to the under side of the top of the conduit from which they are insulated, and are connected by pins H^2 with the outer ends of the sliding blocks *G*, being pressed outward at their lower ends by springs H^1 fastened to the upper blocks *C* and bearing against the plates. As the springs H^1 press the lower ends of the plates outward they also draw the blocks *G* outward until the flanges at the inner ends of the blocks strike against the inner flanges of the guide boxes *F*. The bottom *J* of the conduit is provided with a series of slots *K*, through which the accumulated water can pass into a trough *L* arranged below the sleepers *M*, the entire length of the conduit.

From the bottom of the car two bars *N* project downward, and each contains a sliding bearing block *O*, which is pressed downward by a spring O^1, and in these blocks the shaft *P* is mounted, which carries on its end a wheel *Q*, having a beveled edge. This wheel passes through the slot of the conduit and bears against the plates *H*. As the wheel *Q* rolls along it presses the successive plates inward. By this means the sliding blocks *G* are successively pressed inward and their inner ends brought in



NEW FORM OF TROLLEY CONDUIT.

contact with the naked side of the conductor *D*. The current passes from the conductor through the blocks *G*, the plates *H* and the wheel *Q* to the motor in the car. As soon as the wheel *Q* passes over one of the plates *H* the plate and the corresponding block *G* are drawn outward by the action of the spring *H'*, and thus the circuit is broken. The car circuit is closed only then when the wheel on the car bears on any one plate.

It has been generally reported that the Lynn, Mass., and Boston electric system is to put on an express and light freight service. Aside from using one freight car, twenty feet long by six feet high and wide, for its own service, nothing has been decided. The system is admirably adapted for such a service, covering 150 miles of track and connecting eighteen towns and cities.

Elevated Electric Railway Agitation in Chicago.

"We have been told again and again that we must discard steam and use electricity. Well, we probably will." This is the statement that the newly elected president of the Chicago South Side Rapid Transit company, of Chicago, M. Hopkins, made in an interview last week, and what he predicts for his own road may be applied not only to the elevated roads of Chicago but to the majority of similar roads in this country. Electricity as a motive power has been steadily gaining the confidence of unprejudiced railroad promotors and engineers, and the economic results which have been gained by its use have become so well known, that to-day in Chicago two new elevated railroad companies have been figuring upon its adoption and the South Side company, at present operating by steam, is seriously contemplating the change. It is not surprising that Chicago should take such a decided lead in this matter, for an object lesson is usually of much more value than many theoretical arguments, and the Intramural road at the World's Fair has most successfully accomplished its object of demonstrating the superior merits and greater economy of the electric system. B. J. Arnold, who designed the plant, has carefully worked out the comparative economy of the steam and electric systems and he is in a position to speak positively of the saving in operating expenses where cheap slack is burned under the boilers and electrical power transmitted, over a system where hard coal at $6 a ton is burned upon each engine, requiring the employment of many firemen. This is the point upon which the question must ultimately be decided, and Mr. Arnold's figures will do much to decide exactly the economy of electrically transmitted power.

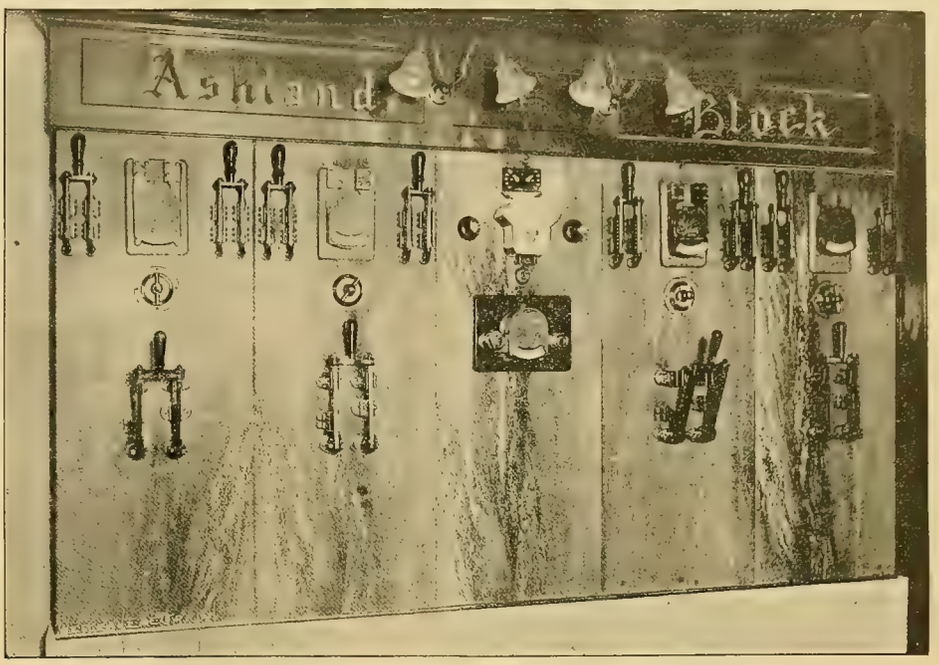


FIG. 2. ELECTRICAL EQUIPMENT OF THE ASHLAND BLOCK, CHICAGO.

That these facts have attracted the attention of the management of the South Side Rapid Transit road, and that these gentlemen have taken the matter under serious consideration is shown by President Hopkins statement. It has been rumored for some time that a change of motive power upon the road had been made the subject of much discussion, and it was thought that at the meeting of stockholders held last week the subject would be brought up. Although such was not the case, Mr. Hopkins has spoken on the subject freely and at some length. He said: "We have held several interesting conferences with the Siemens & Halske people, the Western Electric company and other electrical concerns, and we have given a great deal of attention to the direct current third-rail system, which was used at the World's Fair. Now, we have been advised by the very same people who told us we must make a change to go a little slow. They tell us that they are working on the three-phase system, which they say is more economical than the other. They cannot tell us when the three-phase system will be perfected, yet they tell us to wait. The whole question comes to this: Will it be cheaper for us to burn coal screenings at $1.20 to $1.60 a ton, or continue to burn hard coal at $6 a ton? There it is in a nutshell. If we can put in a central power plant and burn cheap screenings as the others do, in a Murphy or similar furnace, and get the same results we get now, then electricity is what we want. Our compound engines are doing all that they were built to do. They are economical and good power developers, but they labor under two disadvantages—hard coal at $6 a ton, and the frequent stops they must make at stations and curves."

Other stockholders did not hesitate to say that the question had been under consideration for some time, and that in all probability in the future motors would be hauling the cars on the alley "L."

It has been known for some time that the company building the new Metropolitan elevated road on the West Side, has also been inclined to give electricity a considerable amount of attention, and it was learned last week from an engineer familiar with the company's plan that an order given for steam locomotives at a recent date had been temporarily suspended by the company, although not rescinded with the idea of taking the opportunity of securing data upon the operation of elevated electric traction. These investigations are being quietly made and the present agitation will doubtless do much to obtain a fair hearing for electricity, and it is among the possibilities that the Metropolitan company will declare in its favor.

As noted in the last issue of the WESTERN ELECTRICIAN the Northwestern Elevated railroad company has practically decided upon electricity for its proposed extensive system. At the last week's meeting of the council Mayor Hopkins presented his veto of the original ordinance of this company. In this ordinance no provision was made for a definite route to be constructed and no compensation to the city was provided for other than the annual license fee of $50 for each car used. The mayor objected to this and also to the fact that the question of time limitation was somewhat ignored. He suggested an elevated road connecting the business portion of the city with Wilson avenue, striking Graceland avenue at some point between Clark street and Evanston avenue, striking Diversey street somewhere between Halsted and Clark streets, and striking Belmont avenue at some point between Clark street and Evanston avenue, would furnish rapid transit facilities where they are most needed, and that the company should be required to build the road connecting the business portion with Wilson avenue, upon the route indicated, within three years. The company should also, he said, be required to complete its route to the northerly city limits within ten years, and its failure to do so should subject it to the payment of $25,000 for every mile of road not built within that time as liquidative damages.

The chief amendment was made to the clause compelling the payment of an annual license fee of $50 per car. It provided that after the expiration of ten years, from and after the commencement of the operation of the elevated road, or some part of it, the company shall pay into the treasury of the city annually a percentage of its gross receipts from the operation of the road and its branches as compensation for the benefits conferred by this ordinance upon the company, as follows: One per cent. for a period of ten years, two per cent. for the following period of ten years, and three per cent. for the remaining twenty years. Another

amendment compels the company to file plans for all the routes within a year after the acceptance of the ordinance. It is also provided that the ordinance must be accepted within thirty days. The main line route was amended to read as follows: For the main line of the railroad commencing at Congress street, or at a street or point north of Congress street, and between Wabash avenue on the east and Market street on the west, and extending in a northerly and northwesterly direction to the Chicago river; thence across the Chicago river to a point between Cass street extended to the Chicago river and the north branch of the Chicago river; thence extending in a northerly and northwesterly direction to the city limits. The council then passed the amended ordinance. The projectors of the road announced that they would not accept the amended ordinance. D. H. Louderback, the principal promotor of the scheme said in an interview on Friday of last week:

"We have been unable so far to get an official copy of the

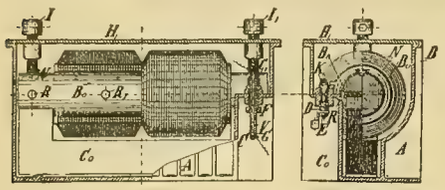


FIG. 4. CENTRAL STATION AT FUERSTENFELD-BRUCK.

amended ordinance and I therefore could not have a meeting of my associates in regard to it. From what I am told about the amendments there is one, in my judgment, that would prevent the road being built or capital being interested, and that is the mayor's amendment in regard to building from Wilson avenue to the city limits within the ten-year period, subject to a forfeiture of not only all of the company's branches but the road already built from the business district to Wilson avenue, which will undoubtedly involve the expenditure of at least $6,000,000 or $7,000,000. This is discounting the future more than any conservative business man dare do. We might have misfortune come upon us later on, and to say that in such an event our entire property must also be swept away is unquestionably unfair. We have none but sound, conservative business men in our enterprise, and we are willing to

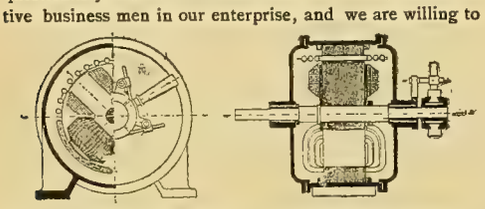


FIG. 6. CENTRAL STATION AT FUERSTENFELD-BRUCK.

show our good faith by agreeing to accept the mayor's penalty of $25,000 a mile forfeit for each mile not completed within the time limit north of Wilson avenue.

"The second objection I see is the short time allowed us to file our official plats of all our routes, which, I understand, is only twelve months. This is all right for the main line north of the city limits, but for our branches we should have at least twelve months more.

"The third objection I see is one that in my opinion is vital; that is: Where are we going to land passengers in the down-town district? By confining us between Market street on the west and Clark street on the east and Monroe on the south they virtually force us to make our terminals between Market street and a point midway between Wells and La Salle street. By examining the ground anyone can see at a glance that we cannot come down between Clark and La Salle. We think we should have the limits between Market street on the west and Wabash avenue on the east and at least Monroe street on the south to see if we cannot find a route that will enable us to land our people more in the vicinity of the retail district and large office buildings where the people are. This is the weak point of all of the existing elevated roads. The people have to walk too far. The proposed patrons of the road are as much interested in this as we are, and they should make themselves heard and felt.

"With these objections removed I am satisfied my associates who have pledged me the money to build this road, providing we can secure a satisfactory ordinance, will accept the conditions imposed by the mayor in regard to the percentage on our gross receipts. While it is unduly heavy and is virtually taxing our property three times, as we are obliged to pay taxes on our tangible property, a license fee of $50 a car and the tax of 1, 2 and 3 per cent. on our gross receipts, we will show the people by accepting this that we mean business."

Last Monday night for the third time the company's ordinance passed the council. The mayor, it is stated, has signified his intention of signing the measure as last amended, and Alderman Tripp, on behalf of the promotors of the road, said that in all probability the twice-amended ordinance would be immediately accepted and preliminary work on the road begun at once. The prinpal feature objectionable to the company, which has been eliminated from the franchise, is that portion which pertains to the completion of the road to the city limits, within ten years, under penalty of forfeiture of all privileges granted to the company. The territory in which the southern terminus of the road must be made, which was confined between Clark, Market and Monroe streets, was extended by making Wabash avenue in place of Clark street, the eastern boundary line. Other minor changes were also made.

Now that the final ordinance has been passed, the names of the prominent capitalists back of the enterprise have been mentioned, and the list is said to include a number of gentlemen connected with the electrical industry, such as W. G. Beale, J. W. Doane, John I. Beggs, F. S. Gorton, Samuel Insull, Norman Williams, D. H. Louderback, C. R. Cummings, John M. Clark, R. C. Clowry, B. E. Sunny and G. H. Wheeler. Other strong names in the list are those of Marshall Field, John J. Mitchell, Orson Smith, J. L. Cochran, Alex. Clark, C. L. Hutchinson, C. Counselman, George M. Lyon and E. M. Phelps.

The Central Station at Fuerstenfeld-Bruck.

The council of Fuerstenfeld-Bruck, having at its disposal at Schoengeising a hydraulic installation, determined to use it in the production of electricity for lighting the city, and gave O. von Miller charge of the work. Mr. von Miller has described the plant in a recent issue of *Electricite*, from which the facts and illustrations herewith given are reproduced.

Fig. 1 shows the arrangement adopted by the author for the transmission and distribution of the current. It was decided to adopt the alternating system, as it permitted the conduction of energy to a great distance with the least loss. The fact that this system did not permit the accumulation of the energy was here of little importance, as the water power was more than sufficient to insure at all times a regular service. The alternators W_1 and W_2, Fig. 1, produced a potential of 2,600 volts; they were coupled in parallel and connected with the city of Bruck, about five miles distant. Here the transformers reduced the pressure down to 100 volts, and at this voltage the current was distributed about the city. From the center of the network two-pressure wires went back to the station, and one of these was used for the telephone circuit.

The turbines, Fig. 2, were operated by power from a branch of the river Amper. Their speed varied little with the delivery; the regulation was affected either by hand or automatically by means of a valve. The alternators, as well as the transformers, were furnished by Brown, Boveri & Co. The line was formed of wires six millimeters in

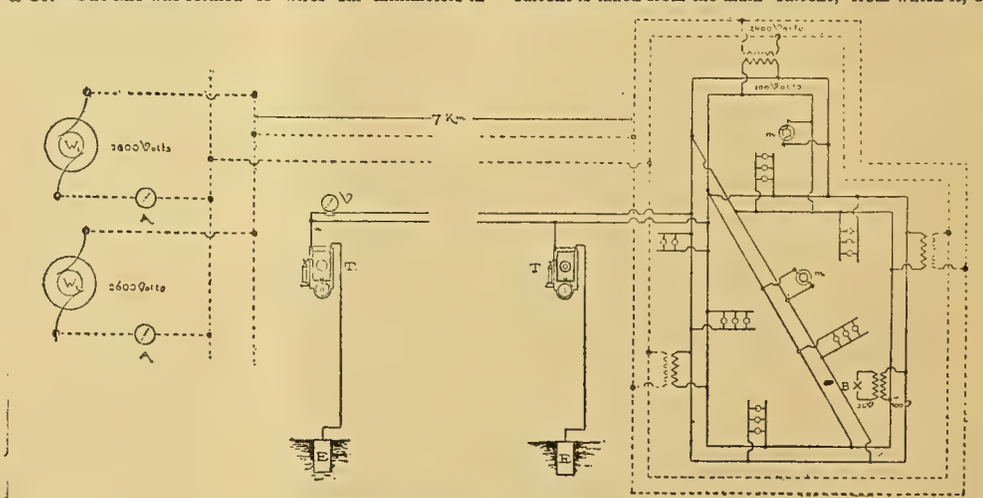


FIG. 1. CENTRAL STATION AT FUERSTENFELD-BRUCK.

diameter, supported on ordinary insulators. The telephone line was parallel with the high tension wires and fastened to the same poles, and, although it had no metallic return, the telephone service was excellent.

Within the city limits the wires were supported on very high poles that carried the wires over the tops of the houses. There were ten transformers in all at different points in the city; some of them being protected in cabinets, as shown in Fig. 3. Before entering the transformers the primaries passed through lead fuses and a lightning arrester.

An idea of the construction of the Brown transformer will be had by reference to Fig. 4. The coils are contained in an iron box, and are surrounded by oil. The secondary wires pass along the streets in front of the houses, to which they are attached by various kinds of supports. A specimen of arc lamp construction is shown in Fig. 5. The arc lamps are each fed by a special trans-

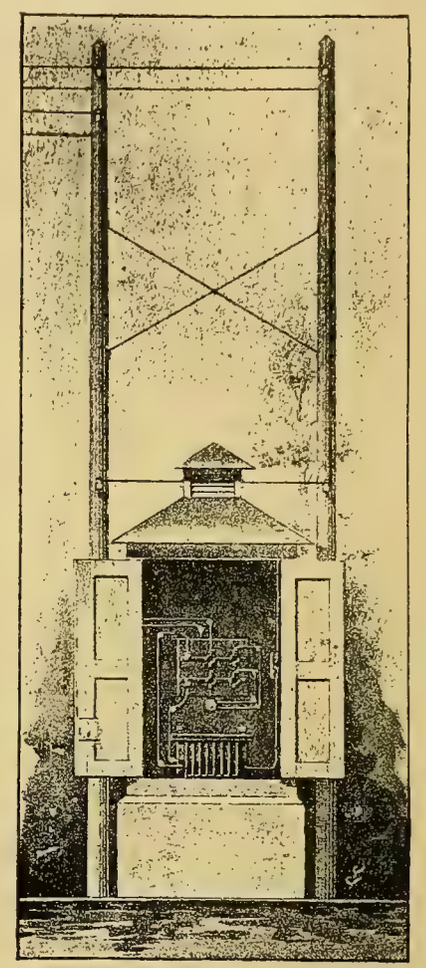


FIG. 3. CENTRAL STATION AT FUERSTENFELD-BRUCK.

former, as it was found not practicable to connect two in series.

The Brown alternating current motor employed in the station is shown diagramatically in Fig. 6. It is a four-pole machine, and is so constructed that the starting is accomplished gradually and without any jar. The exciting current is taken from the main current, from which it, of course, is commuted into a direct current. This motor, it is asserted, can be overloaded 200 per cent. without the slightest danger. The cost of maintenance is said to be reduced to the renewal of the weekly supply of oil, and a 10 horse power motor requires no larger space than one cubic meter.

The plant at present is run by two turbines of 68 horse power each, but later a third will be installed. With a loss of 17½ per cent. on the line, 1,300 lamps are connected.

The cost of this installation, not including the fixtures

which are paid for by the consumer, was 74,000 francs ($14,800). Mr. von Miller has proposed to charge $5 a year per 16 candle power lamp, and to furnish, at all hours of the day, current for light, heat or motive power. The method employed with customers is to allow each a maximum amperage, and to install in his place a cut-out that will not allow an excess of current to pass. The motors will be charged at $90 per horse power per year, that is about 25 cents a day, which is very reasonable. In the town of Bruck seventy houses will ultimately be lighted by 1,500 lamps and seven arcs, and a dozen or more motors will be furnished current. For a

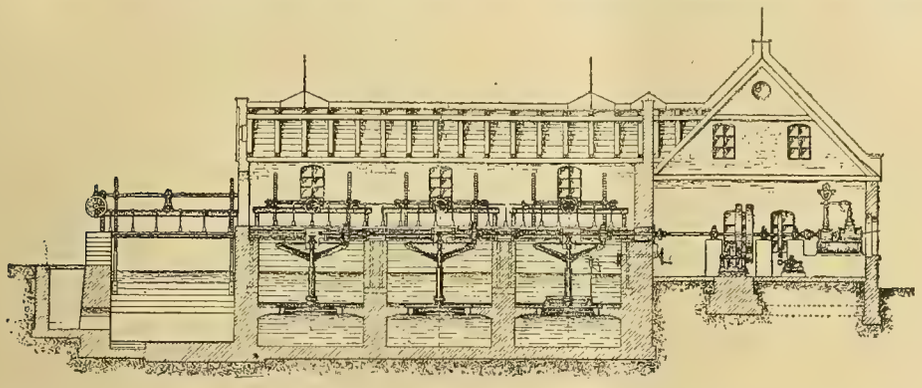


FIG 2. CENTRAL STATION AT FUERSTENFELD-BRUCK.

modest village of 3 000 inhabitants this is a very satisfactory result.

Cape Town Electric Light Station.

The firm of Siemens & Halske, of Berlin, has secured the contract for the entire work on the electric lighting plant to be erected at Cape Town, South Africa, with the exception of the buildings and the pressure leads of about 6,500 feet in length. The installation will comprise a sub-station of accumulators, situated outside the city, from which the distribution of current will be effected over the entire city on the five wire system.

The arrangement of the primary station is such that each of the two dynamos can be directly connected both with a turbine and with a steam engine, so that either the turbines or the steam engines can supply the motive power. The turbines to be supplied are of the vertical type with partial admission, and each of 200 horse power, at 250 revolutions per minute. The water, introduced by a pipe 6,500 feet in length, has an available fall of 670 feet. The two steam engines will be of the compound-condensing type, with vertical cylinders, working at a pressure of 100 pounds, at 250 revolutions per minute, giving 200 horse power. The steam will be supplied by two circulating tubular boilers, each having 150 square meters heating surface. The preliminary work is being rapidly advanced, and it is expected that the installation will be completed before the expiration of this year.

High Resistance.

In various experiments very high resistances are necessary, but it is not the easiest thing in the world to find just whatis desirable. If wire is used some thousands of feet may be necessary. Plates of glass and ebonite in the form of pencils have been used, but these are not only fragile but they are subject to changes. E. Jona, of Milan, has recently sent to *La Nature*, sketches and a description of a high resistance, which he has used with success in his experiments. The sketches are produced herewith. A cylinder of ebonite E, Fig. 1, is covered with a paste composed of ordinary unvulcanized ebonite thoroughly mixed with lamp black. The whole is then subjected to vulcanization,

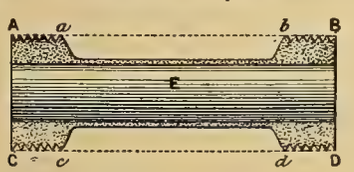


FIG. 1. HIGH RESISTANCE.

which causes the two kinds of ebonite to adhere the one to the other. The surface of the cylinder is turned off on a lathe, and the central portion *a b c d* is made thin. At the ends are cut threads in which binding posts of bronze may be inserted. Thus a hollow semi-conducting cylinder of ebonite, with very thin walls, is produced, and it gives a resistance of a megohm for a length of 10 centimeters, when the diameter is 15 millimeters. Still greater resistance can be secured by cutting the central portion in the manner shown in Fig. 2. This produces a series of teeth, in which the upper part is semi conducting ebonite and the other part is insulating ebonite. In order that terminals may be attached to the cylinder a coil of wires, Fig. 2, may be inserted in the paste of ebonite before the vulcanization process, which by hardening the pasty mass will fix them in position.

Death of William Richardson.

William Richardson, known to street railway men throughout the country as the president of the Atlantic Avenue Railroad company, of Brooklyn, for many years, died at his home on December 31st. Mr. Richardson, who was a native of England, was 71 years of age. He had been engaged in the street railway business since 1865 in New York and Brooklyn, organizing the Atlantic Avenue company in 1872. He gradually extended its lines and built up the property until it was sold for a large sum to the Brooklyn Traction company last year. Mr. Richardson probably had more exciting experiences as a street railway president than any other man in the country. He was a devout Baptist and an active member of the Hanson Place church of that denomination, so that he came to be called the "Deacon," although he once said that he never held this office. About ten years ago he succeeded in getting his line laid in Seventh avenue. The franchise for the street was secured several years before, but the property owners obtained an injunction preventing the laying of tracks, as it was a fine residence street. Mr. Richardson made all his preparations secretly for the work,

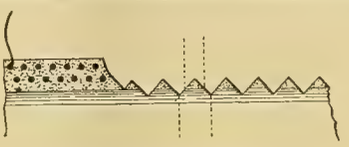


FIG. 2. HIGH RESISTANCE.

and on a Saturday afternoon he obtained an order dissolving the injunction. To prevent the obtaining of another he waited until midnight, and then a large force of men went to work, tore up the asphalt pavement and laid rails as rapidly as possible. When the residents rose they found that the tracks were down for several blocks, and they had to submit. Mr. Richardson was afterward brought to trial in the Hanson Place Baptist church for "disorderly walk and immoral conduct." He was found guilty and suspended. But he secured a reversal of sentence on some technicality, and at another meeting was permitted to apologize and show proof of repentance, and was taken back into the church, remaining a member until his death. He had some interesting experiences in street railroad strikes. In 1886 he undertook to quell a strike on the Dry Dock road in New York, in which he owned a large interest, and all his men in Brooklyn also struck. But he successfully managed both strikes, and did not grant the demands of the men. He had Superintendent Murray and 600 policemen take a car through Grand street, New York, and Police Commissioner Carroll ride on the front of a car to awe the strikers in Brooklyn. In the last strike on his lines in Brooklyn, in 1889, he rode on the front of the first car that was run, a conspicuous figure, with his snow-white hair and full white beard. In that he also beat the men. Within the last year or so the road with which Mr. Richardson was so long identified has been operated by electric power. A son of the deceased, William J. Richardson, is also a prominent street railway man, being secretary and treasurer of the American Street Railway association.

Negotiations for an electric railway, taking in Pomona, Claremont, Ontario and Chino, all of California, are proceeding satisfactorily. Prof. Baldwin, of Pomona College, is interested in the scheme, and it is said the storage battery system is under consideration.

Aid for the Unemployed.

A committee consisting of E. M. Barton, W. H. McKinlock and F. W. Cushing, appointed by the Central Relief association to interest the electrical men of Chicago in the work of providing assistance for the very large number of destitute persons in the city this winter, called a meeting of representatives of the electrical interests of the city at the Union League Club on Friday of last week. H. B. Craigin of the Central Relief association—an organization of business men formed to meet the situation—explained the urgent need of money to relieve the widespread distress existing by reason of the depressed state of business, and a number of sub-committees were appointed to aid in the work of raising funds. Active operations for the relief of the army of unemployed in Chicago have already been begun, and it is considered that the plan adopted must be carried out for some time to come—perhaps two or three months—if grave consequences are not to result. It is hoped that the electrical trade will not be more backward than other branches of business in bearing its share of the burden, and, whether personally solicited by members of the committees or not, the electrical concerns of the city will do well to send contributions by check to Lyman J. Gage, the treasurer of the Central Relief association, in care of the First National Bank.

General Electric Changes.

The general offices of the General Electric company are about to be removed from New York to Schenectady, N. Y., and the little city on the Mohawk will hereafter contain the headquarters of the company as well as the main factory. Some offices will be retained in the Edison building at 44 Broad street, New York, however, for the eastern sales department. The only other district office will be at Chicago, to which Capt. Eugene Griffin will

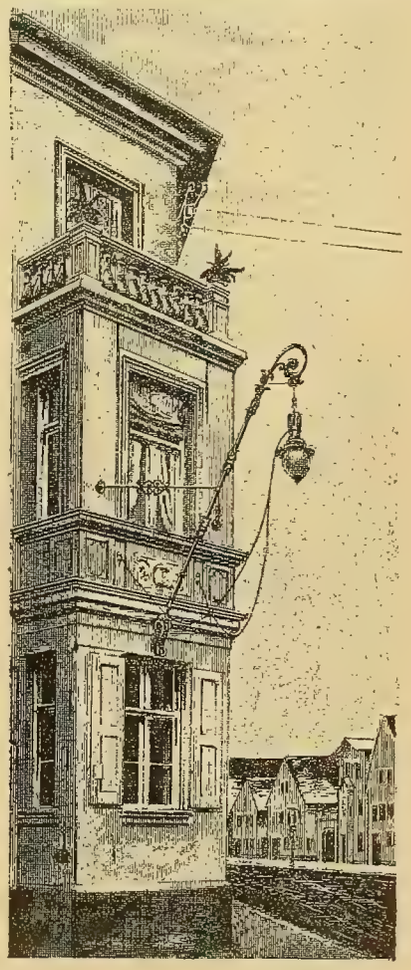


FIG. 5. CENTRAL STATION AT FUERSTENFELD-BRUCK.

devote considerable attention. It is said that all the heavy machinery will be manufactured at Schenectady, and that the Lynn factory, with a greatly reduced force, will be conducted as a sort of annex for the production of arc lamps and "such small standard articles as are required in large numbers." The incandescent lamp works will remain at Harrison, N. J. It is asserted that Prof. Thomson and Superintendent Rice have been requested to remove from Lynn to Schenectady, and other rumored changes are impending.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise ,well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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WE have tried advertising in several electrical papers, and after discontinuing our advertisement in your journal [*Electrical World*] we advertised for a considerable period in the WESTERN ELECTRICIAN, which we found a valuable paper for reaching the West, our card in that paper bringing us many communications, a number of which resulted in sales of our alternating apparatus, including a plant for the University of Wisconsin.—*Extract from a letter of F. A. La Roche, president of the La Roche Electric Works, Philadelphia, to W. J. Johnston, publisher of the Electrical World.*

ATTENTION is called to the movement on foot to interest the electrical business men of Chicago in the effort to extend adequate aid to the unemployed of this great city through the medium of the Central Relief Association. The amount of destitution existing at present in Chicago has not been equaled for twenty years, and extraordinary measures are needed to meet the situation. The electrical industries probably suffered as little as any in the business depression that characterized the latter half of 1893, and it is their duty to respond promptly and generously to the appeal for help.

THE discussion in the British Institution of Electrical Engineers on Prof. George Forbes' paper on "The Electrical Transmission of Power from Niagara Falls," a portion of which is reproduced in this issue, is of great interest. Not all the members agreed in the conclusions reached by Prof. Forbes, and the criticisms were pointed and freely expressed. Some of the leading electrical engineers of England took part in the discussion, and the report indicates that the session possessed a lively interest.

THE incandescent lamp situation continues to present many features of interest. All the companies seem to be busily engaged in cutting rates or meeting cuts, and meanwhile the Edison people are tenacicusly pursuing their policy of shutting off competition. The latest suit is of particular interest from the fact that the defendant company manufactured a lamp which was lately brought out as non-infringing on account of the introduction of gas in the bulb. The judge, however, decided that this was not a good defense, thus holding that a gas incandescent lamp infringed the Edison patent. If this decision is upheld by the appellate court as good law, it will have an important bearing on lamp manufacture. So far the only successful defense to the Edison claim has been the contention that Henry Goebel produced incandescent lamps antedating Edison's invention, and the case in which this was held is still pending in the courts on appeal. Indications point to a good demand for incandescent lamps in the immediate future, and the "outside" companies will undoubtedly make every effort to secure their share of this business.

IF Mayor Hopkins signs the Northwestern Elevated railroad company's ordinance as last passed by the Chicago council, an era of interesting electrical construction will undoubtedly be entered upon. It seems to be the accepted opinion that this proposed elevated road will be operated by electricity, and the adoption of this motive power by the North Side company may influence the decision of the directors of the Chicago South Side Rapid Transit company to a considerable extent regarding a change of motive power on their road. By referring to the article on another page it may be understood to what extent the subject of elevated electric roads is being agitated in this city. The prospect of such an extensive demand for electrical railway machinery and supplies should be very encouraging to electrical men and may prove an important factor in returning business confidence. In the project immediately under consideration many engineering difficulties must be encountered by the constructing engineers, such as crossing the Chicago river, and the possibilities of a tunnel under the river are already being discussed. Electrical engineers will watch the development of the plan with great interest. It can hardly be doubted that the Northwestern road will be a pioneer in a field destined to be well filled.

APROPOS of the discussion in relation to "branch meetings" of the American Institute of Electrical Engineers it is interesting to note that in England a new electrical engineering society has been formed under the title of the Northern Society of Electrical Engineers with headquarters in Manchester. The members of the profession in the midland and northern counties felt that little opportunity was afforded them of meeting outside of London for scientific discussion and social intercourse, and a movement was set on foot which resulted in the establishment of the new organization. It is explained that the society is not founded with any view of rivalry or opposition to the existing British Institution of Electrical Engineers, but it is a significant fact that the Manchester electricians did not propose to attach themselves to the old society as a "branch," with an "honorary secretary" and instructions to give out none of the proceedings without the revision and permission of the main office. They do these things differently in England, and, although Manchester is but 200 miles from London, the electrical men of that city preferred to run their own affairs. New York and Chicago are 950 miles apart, and it would seem that the reasons actuating the electrical engineers of Northern England would have much more forceful application in the similar condition of affairs existing on this side of the water. No American city occupies a position of importance in this country equivalent to that of London in Great Britain, and the area of the country is also so great that it is possible within the next few years that the convenience of the profession will be best served by the existence of more than one society of electrical engineers.

A NEW field for the use of the storage battery is suggested by the proposal that the hand-cars now in use on steam railways be propelled by electric motors operated from storage cells. The idea is worthy of investigation, especially in view of the fact that nearly every railroad company now-a-days has one or more electric lighting plants, from which current for charging could be obtained. These storage battery cars would provide a convenient means of going rapidly from the division superintendent's headquarters to points on the line within a prescribed distance from the charging station. There is a great demand for a small car suited to rapid movement, and this demand has reached such a point on some of the eastern roads that the division superintendents are each provided with a small locomotive specially designed for this service. These locomotives are used, not only by the division superintendents, but by other officers as well, and are found so useful that they have few spare moments. The machines in question are much more elaborate and expensive than is necessary for such service, and a much cheaper one could be used quite as well. Storage battery cars would serve this purpose excellently, provided, of course, that charging stations were accessible.

GOVERNOR FLOWER is a warm friend of the project for utilizing electrical power for the propulsion of boats on the Erie canal, and in his annual message he alludes to the subject at some length, urging the New York Legislature to give the matter earnest attention. The plan of using a trolley to convey the current from overhead wires to the motors on the boat presents many difficulties aside from the question of economy, but he thinks that they can all be overcome. Much stress is laid on the fact that cheap electrically transmitted power may be had from Niagara Falls. This implies, however, the commercial success of that project, a transmission of over 300 miles and the use of alternating current motors. On the other hand, it is a grave question whether the direct current system, with coal-burning power houses, say fifteen miles apart, could economically be employed. The problem is hedged with difficulties on every side, but it is one of such importance as to justify earnest study.

The technical difficulties naturally present themselves to the state engineer, who has prepared a report more conservative on this point than that of the governor. In discussing the transmission of power by alternating current at long distance from Niagara falls, this official says: "The method of generating electricity in large quantities at points where large water powers exist and thence transmitting it by wire over long distances is the one which, to my mind, contains the greatest promise of success. In order, however, to economically transmit the large quantities required, the current in the feed wire must pass at a very high voltage, and in order to secure safety that in the trolley wire must pass at a low voltage. While it is perfectly feasible to transform an alternating current from a high to a low and from a low to a high voltage, unfortunately no means have yet been found for thus dealing with a continuous current, and it is the continuous current alone that has as yet been successfully applied to the operation of motors." The state engineer confuses the question somewhat, for of course motor-generators could be used to transform continuous currents if there was any object to be gained thereby. However, it is true that the alternating current plan is the more feasible, and, as Mr. Schenck intimates, it would be difficult to put one's hand on an alternating current motor that would fulfill the requirements. The state engineer does not despair, notwithstanding, and concludes by expressing the hope that the Legislature will adopt the necessary measures to secure the continuance of the investigations and experiments necessary to reach a conclusion.

One of the novel plans proposed is the establishment of a double-tracked electric railway line on the towpath, with motor cars to tow the boats. But this idea is open to so many objections, including that of cost, that it seems hardly possible that it will be seriously considered.

Electrical Canal Project Favored.

In his annual message to the Legislature of the state of New York, Governor Flower comments very favorably on the proposal to operate the boats on the Erie canal by electrical power. He says:

It has seemed to me, however, that the most practical plan for immediately increasing the tonnage of the Erie Canal is that which would supply a speedier and more economical motive power. Mules and horses now propel canal-boats at a rate of about two miles an hour, while steam sends them along at the rate of about three miles. The banks of the canal will stand a speed of about four miles an hour. It seemed to me after personal observation of present methods, that electricity might be applied as a motive power with a considerable saving in cost and a considerable increase in speed. Experiments in this direction were authorized by the last Legislature upon my recommendation, and seemed to have demonstrated clearly the feasibility of using electricity as a motive power on the canals. The only question still to be determined is that of cost, and the estimates are quite favorable to a considerable reduction from the cost of propulsion by steam. Just how much of a reduction could be obtained it is of course impossible to say definitely, but very conservative estimates make the saving in cost of transportation at least 25 per cent., and the increase in speed at least 30 per cent.

The advantage of electricity over mule or horse power would be much greater. If these results could be attained the benefitto the canal would be immediately greater than the benefit which would result from all the proposed enlargements, and need not cost the state a penny. Boatmen could make many more trips in a season, fewer employes would be needed on each boat, no money would be required for horses and mules, the large space occupied by steam boiler and engine would be saved for freight, and danger from fire or explosion would be avoided. At the same time, the increased tonnage and business of the canals would provide more employment and more remunerative occupation for boatmen, other advantages readily suggest themselves. It should be clearly understood, moreover, that the adoption of electricity as a motive power does not mean the abandonment of horse, mule or steam power, if boat-owners prefer to have their boats propelled by these powers. The idea is that, whether the state furnishes the electric power from its own plant, or whether individuals or corporations furnish it under contract, there will be no compulsion to use it, but the endeavor will be to supply it at such a low cost to boatmen that they will find it advantageous to apply it to their boats in the interest of economy.

This plan need not interfere, either, with any proper enlargement or deepening of the canal. Indeed, if the plan is found to operate satisfactorily, the next logical and necessary step would probably be to so improve the canal as to enable the use of larger boats. But for the present I am quite convinced that the proper course is to give electric propulsion a fair trial, and, if it accomplishes what is claimed for it, a new era of activity and prosperity should begin for our canals. Grain has been carried during the last season from Chicago to Buffalo for as low as one cent a bushel; boatmen can carry it profitably at two cents a bushel. If, by cheaper and quicker propulsion, the cost from Buffalo to New York by way of the Erie Canal can be reduced to three cents a bushel, as is reasonable to suppose, there is no other carrying route that can successfully compete with it, and a continuance of New York's supremacy is assured. Moreover, the harnessing of the tremendous water torrent of Niagara to the wheels of industry will furnish the cities of Buffalo and Rochester, and all Western New York with the cheapest power for manufacturing in the United States.

We may look forward to the time when the great flour mills of the world will be located there, for the cheapness of power would more than compensate for the cost of transportation of grain from the fields of the Northwest. So with other manufactories. Then, more than ever, will be needed cheap transportation through the state. To-day the Erie Canal does not carry one-half its capacity. Reduce the cost of transportation, and increase the speed and the tonnage will increase, and when the tonnage increases then will be the proper time to seriously consider expensive schemes of enlargement.

The essential point in arranging for the application of electric propulsion on the canals is that the power should be furnished at the lowest possible cost, and any construction of the state works for this purpose, or any contract with individuals or corporations for supplying power to the boatmen, should be hedged about with abundant safeguards for the protection of the public interests.

State Engineer Schenck, in his report, naturally devotes more attention to the technical problems clustering about the proposed improvement. He says in substance:

While there are some minor difficulties to be overcome in the application of the trolley system to canal navigation, such as the holding of the boat while not in motion or moving at a low rate of speed and exposed to the action of high winds, in proper position to secure easy contact of the trolley with the wire carrying the current, the devising of means by which boats traveling in the same direction at different rates can pass each other, or by which boats can be brought up to or taken away from a deck, etc., I think none of these difficulties are so serious but that they will be surmounted by the inventive genius of our people. The main question is a purely economic one, and the success or failure of investigations now in progress will be decided by the answer to the question: Can the electric power be furnished to each propeller at less cost than that of steam?

Two trolley methods have been suggested by which to reach the desired end—one by establishing power houses along the line of the canal at such distances apart as may be found economical or desirable, and in these power houses, by the use of fuel to generate steam, transform this steam power into electric power, transmit this electric power by wire between these power houses, and by means of a trolley wire communicate it to motors in canal boats acting to turn a screw wheel. The other is the generating of electricity in large quantities by means of water power at some point or points where nature has provided the means, and then transmitting the current over long distances by wire.

From the figures furnished by the Albany electric railway, I conclude that if, as was shown me, we succeeded in developing an engine cylinder one horse power per hour with two pounds of coal, we would have a consumption of coal to obtain one horse power per hour applied at a distance of eight miles from power house of from four and a half to four and three-quarters pounds. This is in excess of the amount of coal consumed by canal steamers, to say nothing of difference in first cost of plant required.

The method of generating electricity in large quantities at points where large water powers exist and thence transmitting it by wire over long distances is the one which, to my mind, contains the greatest promise of success. In order, however, to economically transmit the large quantities required, the current in the feed wire must pass at a very high voltage, and in order to secure safety that in the trolley wire must pass at a low voltage. While it is perfectly feasible to transform an alternating current from a high to a low and from a low to a high voltage, unfortunately no means have yet been found for thus dealing with a continuous current, and it is the continuous current alone that has as yet been successfully applied to the operation of motors.

Upon the solution of one or the other of these difficulties, and upon the devising of means to more economically and perfectly insulate the feed wires, depends, in my opinion, the success or failure of the efforts now being made in this direction.

I am advised that there has been developed by a corporation operating at Niagara Falls a water power yielding on the American side 200,000 horse power per hour, and on the Canadian side 120,000 horse power per hour, which, they state, could be disposed of at a profit to the corporation at the price of $4 horse power per annum, measured on wires at Niagara Falls, if sold in its entirety. In considering this question it must be remembered that the steamboat has and must continue to hold an advantage over a trolley-propelled electrical boat, in that she is independent of outside aid in navigating the Hudson river.

I commend this subject to your careful consideration, and hope that you will adopt the necessary legislation to secure the continuance of the investigations and experiments necessary to reach a conclusion.

City Electrician Barnes, of Rochester, represented the state superintendent of public works at the recent test of a trolley boat on the Erie canal. His report to the Legislature has just been made public. He says in part:

An average of 24 87 electrical horse power was required to propel the boat at the rate of 2.65 miles per hour against both the current in the canal and a strong head wind, while 26.21 electrical horse power was required to attain a speed of 4 24 miles per hour in the opposite direction. It should, however, be remarked that the machinery was not in proper condition nor well adapted to the purpose, inasmuch as it required 5.35 electrical horse power to revolve the wheel at the same rate of speed out of the water as it did while making the test in the canal.

The loss of efficiency in the motors may fairly be ascribed to the fact that they were operated with acquired power of only about 300 volts on the average during the test, whereas thay were designated to be operated with a current of 500 volts. Taking all these circumstances into account, it may be estimated that with a stronger current and better machinery the same speed would have been reached with an expenditure of not more than twenty-one electrical horse-power.

In regard to the cost of electrical propulsion but little definite knowledge can be deduced from these experiments. The essential element in the case is the cost of establishing and maintaining the necessary power along the line of the canal, and this will necessarily vary at different places, and with different methods of production. Where water power is available and can be cheaply developed, the cost of power will obviously be much less than where it must be produced by steam engines.

In order, however, to reach some definite figure I have made an approximate and very conservative estimate of the cost of equiping and operating a steam and electrical plant capable of supplying with necessary power at least 200 canal boats, distributed over a length of fifty miles of canal. Assuming that this plant is in operation not more than 210 days per year, which is the ordinary limit or the season of navigation, my compilations show that the cost will be somewhat less than ten cents per mile per boat and if the power generating machinery can be used profitably during the remainder of the year in supplying power to manufacturing establishments in the vicinity of the station the cost of the canal propulsion will be correspondingly reduced.

This computation refers to a speed of three and one-half miles an hour for the boats, with two boats coupled together. If four or six boats are coupled together, an appreciable reduction in power per boat is effected, as has been demonstrated by trials with steam canal boats. It must also be remembered that while the foregoing estimate is based on the delivery of current of limited voltage produced by steam power, the promoters of the system of electrical propulsion, on the other hand, expect to obtain the necessary power at very low rates from turbines at Niagara Falls and to use a current of much higher voltage with a variety of new methods of transmission and transformation whereby a great reduction in the cost of delivery to motors in canal boats is anticipated. By well-known electrical authorities I am assured that by the contemplated methods of obtaining and delivering the power the cost of propelling boats by electricity will not exceed five cents per boat per mile.

It will, therefore, be seen that the claims to consideration of electricity as a motive power on the canal are extremely well founded, and that its development is worthy of the utmost encouragement. Electricity may be already considered a fair competitor of steam, with the great advantage that the relatively large space occupied by steam boiler and engine in the boat is saved for freight, that the danger from fire or explosion is avoided and the management of the boats and their propelling is greatly simplified.

The Electrical Transmission of Power from Niagara Falls.[1]

By George Forbes.

Discussion.

Part I.

J. A. Fleming, in opening the discussion, said it was not always that engineers were to be found who were able or willing to take them into their confidence during the constructive stage of their work, and to tell them not merely what they had done, but what they were proposing to do. He would confine his remarks to two points, and the first was the difficulties which might be expected to appear in all cases where electrical transmission of power was conducted over long lines having capacity and self-induction. These difficulties were not merely hypothetical things which were discussed by professors, and might, therefore, be safely neglected when coming to practice, but were exceedingly real, and capable of giving rise to very disagreeable and dangerous effects. One of the great risks which had to be avoided in the construction of these lines was the presence of pressure effects, which occurred when the lines were suddenly connected to, or disconnected from, the machines. Prof. Forbes was quite right in saying that under those circumstances surgings were set up in the cables and in the machines, and that the pressure might become almost anything they pleased; it might become scores, if not many more times greater than the working pressure; in fact, it was impossible to say under some circumstances what the pressure actually did become, and under those circumstances it was of no use to say anything of failure of insulation, for no insulation would be sufficient to withstand the pressures that were brought against them. The methods by which they could be

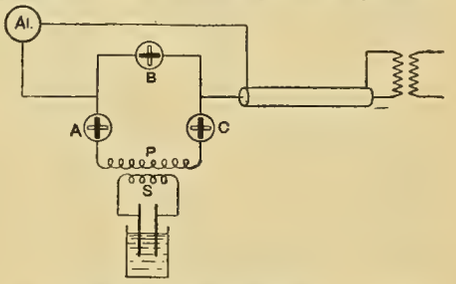


FIG. 1. THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.

controlled had only to be known to be adopted. As Prof. Forbes had mentioned that those difficulties had been got over at Deptford, there could be no objection to his telling them the method adopted by his colleague, Mr. d'Alton, in consultation with himself and others. The way in which it was done now was this: The cable was never suddenly connected, but a transformer was placed in the main, as shown in Fig. 1, and that transformer had on its secondary circuit an arrangement by which it could be gradually short-circuited. A water resistance was generally employed, but it might be carbon resistance. The first process of connecting the trunk main was to keep the switch *B* open and close *A* and *C*, the transformer being open-circuited on the secondary side. Under these circumstances the transformer offered a considerable impedance to the flow of current, and that nullified the capacity effect of the main. The next step was to gradually short-circuit the secondary circuit of the transformer, reducing the impedance of the transformer. When completely short-circuited the switch *B* was closed, and then the switches *A* and *C* were opened, and the transformer was disconnected from the main. In switching off exactly the reverse took place. When dealing with long concentric cables the capacity might reach a very high value—one-third of a microfarad a mile. It was almost impossible to get a cable, if it was concentric, that had not a capacity effect. If they were to adopt a pressure of 20,000 volts, and a frequency of 100, which was probably what they would have done had they started this enterprise in England, and a capacity of one-third of a microfarad with 18 miles of cable, the capacity current in that cable would be 72 amperes when nothing was connected at the other end. That could be easily calculated from the formulæ he gave some time ago. The capacity of that capacity current to do work, or rather mischief, was proportional to the square of the current and to the frequency. Hence the advantage of low frequencies, for the capacity was something enormous when they came to long lines. Concentric cables were, therefore, inadmissable for long lines. He thought there was great safety in using an artificial load in putting machines into and out of parallel. In all Continental stations they did so. When he (Dr. Fleming) was at Rome last Easter he spent a long day with Prof. Mengarini at Tivoli, and the latter allowed him to experiment with the machines there as much as he

1. Read before the Institution of Electrical Engineers, London, November 9, 1893.

pleased. They had an artificial load which took up 300 horse power, and this artificial load was made to resemble as closely as possible the real external line. The process of putting the machines in was this: First of all they put them on to the artificial line, and adjusted the incoming machines so as to give exactly the required current and volts. They then put on two machines and divided the current without any difficulty; then a third was put into parallel, and then a fourth, and a fifth. They were taken out one by one by reversing the process. That artificial line was used in all the Ganz stations, and he thought Prof. Forbes was very wise in making provision for it in dealing with his machines. It was curious that we had not adopted it much in England. He did not know any place where it was used; yet at the same time he hardly knew any large alternating stations on the Continent where it was not done. In the next place he would say one word on the question of pressure. He was very glad to hear Prof. Forbes say he never intended the primary circuit to be opened. But the question naturally occurred would not the primary circuit sometimes open itself? In other words, what was going to be done in the way of main fuses? That was really a serious question in dealing with these pressures. What kind of main fuses did Prof. Forbes intend to adopt? In his paper he mentioned a transformer the secondary of which had a working arrangement which would gradually introduce impedance if the current rose above a certain value. He trusted that that arrangement would be found to work well; but at the present moment one great want in connection with large distributions of alternating currents was an arrangement of main fuses which would not interrupt the circuit, but if the main current went above a certain value would put impedance into the circuit gradually but quickly, and then take it out again as required, but never allowing the main circuit to be broken. The great difficulty at present was that it *did* become broken, and a great rise of pressure took place, with disastrous results to the insulation. The question of pressure was one to which Prof. Forbes and his colleagues had doubtless given very serious consideration before deciding to adopt 20,000 volts. The difficulty which might be encountered with this high pressure was not the difficulty of working with the stock pressure of 20,000 volts, but the tremendous arcs which might be produced if they were started between the conductors. Prof. Forbes did not tell them, he believed, how far apart those cables were going to be in the conduits. He described a conduit in which copper strip was to be used as the conductor, but did not mention what distance they were to be apart. That was a very important matter. It might be impossible under some circumstances to prevent such rises of pressure that an arc would start, and what would be the state of affairs with naked conductors in those conduits if they were only, say, a foot apart? The question was sometimes asked, what is the best frequency to work at? It was very much like asking what is the best speed to walk at? It depended upon where you were going and what you wanted to do. Continential engineers had not been at work at the matter at haphazard when they adopted a frequency of between 40 and 50. Our adoption of 80 to 100 was necessitated by the circumstances under which we had to start alternate current working; and the same in America. But there was no doubt, he thought, about the wisdom of selecting this low frequency at Niagara, where the utilization of power by motors was an important matter, and there was enormous advantages to be gained by the reduction of these capacity effects and other effects of the same kind by the employment of a reduced frequency.

W. M. MORDEY said they were called upon to discuss a paper on a subject of world wide importance, and he believed a sense of responsibility would be felt by all speakers. What made the paper so interesting was that Prof. Forbes not merely described the scheme and the works, but went pretty fully into reasons and principles. It was a very important matter that after so much work had been done on alternate current distribution of all sorts that Prof. Forbes should come there and throw the gauntlet down to the whole industry on two or three points of primary importance in connection with distribution. Those of them, for instance, who had been working at comparatively high periods had to justify their continued existence and to prove that Prof. Forbes was wrong. Prof. Forbes stated in the paper that "it is a matter of common knowledge that parallel working is assisted by lowering the frequency." With all respect, he (Mr. Mordey) would deny that. He thought there was no evidence whatever to show, with any good plant now running, that lowering the frequency had any connection with parallel working. If there was no difficulty whatever in working at 100 periods there could be no improvement in working at a lower rate. It might be that, with certain types of machines, there were advantages in working at lower rates, but he believed that a machine that was incapable of working at 100 periods would work worse at 16 or 40 periods than a machine that would work at 100 periods successfully. The only definite argument Prof, Forbes put forward was a letter from Messrs. Ganz, who had written him "that their reason in adopting the frequency of 42 periods per second was that it is the lowest frequency that is available with arc lights so as not to produce any serious flickering and their desire was to lower the frequency as far as practicable in order to ensure parallel working." Now, Messrs. Ganz were very important people; they had large experience all over the Continent, but it was very necessary to examine and sift statements of this sort, and not to accept them as facts. He thought they ought to ask if Messrs. Ganz had not been a little forgetful in making such a statement as that. In his paper on alternate current working in 1889 he made a similar statement; he quoted a letter by Mr. Zipernowski to the *Electrician* of May 10, 1889, stating that their low periodicity was "chosen on principle," "that we by this means are enabled to couple our dynamos in parallel is not a secondary result, but just the end we are aiming at." His (Mr. Mordey's) surprise was, therefore, very great when during the discussion Mr. Zipernowski wrote: "We state that we have not reduced the periodicity because of the coupling in parallel," and adding that they had always kept to 85 alternations with only slight variations. He happened to know that this last statement was correct. For a considerable time before parallel working Messrs. Ganz had been making alternators of 42 periods per second; when parallel working was recognized to be a necessity they made experiments and adhered to 42 periods, and gave out that they adopted it because it gave the best results in parallel working. I am not aware of any other support than that of Messrs. Ganz to Prof. Forbes' statement, and these words taken from Mr. Zipernowski's own writing showed that his last published statement contradicted his first, and acknowledged that they had made these machines for low periods for years before parallel working was thought of. The question of artificial loading in putting machines on to mains in parallel had also been dealt with by Prof. Forbes, and had been approved very strongly by Dr. Fleming. Now, that was an old, primitive, and he thought an obsolete method. He explained a plan was got out some years ago by Mr Raworth and himself, and published in his paper "On Testing and Working Alternators," by which the regulation of each alternator was entirely controlled by controlling the steam supplied to its engine. There was another question affecting the periodicity to which Prof. Forbes referred as probably the most important. He said: "I am not sure that it ought not to be said that the greatest advantage of low frequency is in connection with the conductors used for transmission, and in the parts of the apparatus that require high insulation." Then he referred to what was strongly pointed out by Lord Kelvin, and which was found out independently by those wonderful experiments of Prof. Hughes' namely, the surface effects in conductors at high frequency, the tendency of the current to seek the outside of conductors. That was, no doubt, in low tension alternate-current distribution, an extremely important matter. But in the case of high pressure and long distance transmission he did not think those Hughes effects, as he would call them, were by any means serious, even for the large powers Prof. Forbes proposed. In 1889 he gave a table of the virtual resistances of conductors, based on Lord Kelvin's figures. In the Niagara scheme at 20,000 volts the full current on one of the machines, with 2,000,000 watts, was only 100 amperes. Prof. Forbes selected 350 amperes to the square inch as a suitable density; he thought a larger density would be more economical unless their power was going to be very costly. But taking that density from his table of Lord Kelvin's results he found that at 100 periods per second, or six times as high as Prof. Forbes intended to use his conductor, there was scarcely any Hughes effect at all. Was it worth while going down to 16 or 25 periods per second in order to get this gain? Still, keeping to the subject of low period city, they came to the question of transformers. He believed it was impossible by any amount of money or space, or time, or thought, to make a transformer anything like as good at a low period as at a reasonably high. It was not a question of design or of money. The ordinary idea that they could design a transformer to be equally good under any given set of conditions, so far as periodicity was concerned, was an entire mistake; it was not possible. If they took a transformer made for 16 periods or 40 periods and ran it at a higher periodicity it would give a very much better result. Prof. Forbes said that by using this low periodicity he had a gain of 3 per cent. more power at his disposal at the other end, and that the transformer only cost about 50 per cent. more. But what did that mean? Prof. Forbes said that a transformer would give 132 units instead of 100 if they doubled the frequency, and if the frequency were quadrupled they would get 174 instead of 100. Suppose he took it at double the output, the hysteresis and C^2R losses remained the same, therefore the proportion of the losses had doubled. He had gone down much further than he need have done. He had a triple transformation, first up from his dynamo to his mains, then from his mains down to the 2,000 volt transformers, and then down to 100 volts probably for his motors, for they were going to be worked at low voltages and with transformers. Therefore, there was a triple transformation, and at the very least a sixfold loss. What did he gain? The author supposed that he got a motor that had 3 per cent. more efficiency than if he used a high periodicity one—a supposition that had no sufficient basis. One thing he approved of, and that was the transforming up from the generator. That was very much better than attempting to generate at 20,000 volts. He did not see why they should transform up from 2,000 volts to 20,000; 2,000 was not so safe as 500 volts, and it was just as easy and cheap to transform from 500 to 20,000 as from 2,000 to 20,000. He would pass over what he had intended to say about the commutation of current, but would just say this: Prof. Forbes had, by this low periodicity, cut himself off from the possibility of using the alternate current directly. He had cut himself off from using current directly in any way except for power; he must always transform up to a higher periodicity if he was going to use his power for lighting.

GISBERT KAPP said there was one point which struck him on reading the paper for the first time, where the author was discussing the merits of the number of phases, whether they should have a single phase or two or three phases. When he (Mr. Kapp) was in America in the summer he had a long talk with Prof. Thomson upon this subject. He was very hazy at the time, he must confess, and Prof. Thomson tried to convince him that three phases would require less copper than two. He could not see it then, but he had since studied it, and read all that Dobrowolski and others had written on the subject, and at last he could see light. The result of his investigation was this: Suppose they found the copper in the line weighed 100 tons when a continuous current is employed. If they now worked a different line with the same length and the same efficiency of transmission and the same stress on the insulators with an alternating current, they would double the copper, which would now weigh 200 tons. If they used two phases with four wires they would again require 200 tons; but if they thought to save copper by using only three wires and working two-phases they would require 290 tons, so that the system which Prof. Forbes recommended as the most economical in copper was actually the worst. If they now had three wires, and worked at three-phases, they would use 150 tons only. Two phase working with three wires was out of the competition altogether; it was too expensive. As regards the motors, he had again the misfortune to differ from Prof. Forbes. The latter thought that the low frequency motor would be more efficient, and at the end of his paper a calculation was given to show that the losses in the high frequency motor were 42 per cent. grater than in the low frequency, He quite agreed with the 42 per cent. but he was afraid that Prof. Forbes had overlooked the fact that with the high frequency they would have to supply two and a-half times the electromotive force, and it would give two and a-half times the power, and, consequently, what appeared to be an increase in the loss of 42 per cent. became actually a gain of 33 per cent., so that on his own showing the high frequency was the more efficient. One reason which Prof. Forbes had given for the use of low frequency, and which had appealed to him (Mr. Kapp) very strongly, was that you could make a synchronising motor out of any daynamo. If they wanted to rig up a motor quickly they could go and buy a dynamo and set it to work. But when he began to consider what had to be done he saw it was not so simple. They had to put on two contact rings to begin with. Dynamos were cut very fine nowadays; makers did not give exta room for fancy fittings. Therefore they had to send it to be fitted with these things by a maker. Supposing they had done this how were they going to start it? Being a single phase motor, it would not start by itself, and they must put down a little Tesla motor, or some other, to start it. And if they did that they might as well use the Tesla motor a little larger and run their factory from it. He would like to point out that single and multiphase alternate current motors were on the market and were very good. The only reason that the impression prevailed in England that they were not to be had, that they were not reliable, and only experimental, was that they placed too much credit on what appeared in the electrical papers. He was afraid the papers were treating them rather badly in this respect. It was the fashion among them to cry down multiphase and alternate current work. He could quite sympathize with the editors; it was an unfortunate thing that they had to take up new subjects and study them in order to write intelligently about them. The ordinary alternating current was bad enough, but when you came to three phases it was really too bad. But they should not cry down these things; let them state what the facts were. He had tested such a motor made by the Oerlikon company, with the following results: The machine gave on the brake 862 watts, and it ran at a speed of 1,800. The frequency varied from 60 to 67; the commercial efficiency was 60 per cent.; the power factor was 74 per cent.; and at starting the current to produce a torque equal to that of the full output of 1¼ horse power was 2¼ times the normal working current. It was rather inconvenient to have such a large current at starting, but by a very ingenious arrangement, now used all over the continent, the mains did not feel this large current. There was an auto-transformer with a switch handle, which, at the expense of pressure, gave the extra current which went into the motors and it worked beautifully. The weight of that machine was under 100 pounds per horse power. There seemed to him to be very strong reasons against the adoption of low frequencies as regards motors, and perhaps not so great, but still sufficient reasons as regards the transformers; one very strong reason was the cost of the alternator. He had studied the design of Prof. Forbes' alternator very carefully, and he might say at once that he was very pleased to be able to agree with him that it was about the best machine that could be made for the job.

PROF. SILVANUS P. THOMPSON said that the paper bristled with points, but he would confine his remarks to one or two. In the first place some rules concerning parallel working were given, or rather some remarks were made about the knowledge, or want of knowiedge, upon that which constituted the successful design of machines for working in parallel. Prof. Forbes said: "The rules which govern the construction of machines which shall work well in parallel are not very clearly understood. The only fact which had been perfectly established in practice is that the lower the frequency the more efficient and sure is the parallel working." He, too, felt disposed to dispute this point. He would not dwell upon it—he simply disputed it; it had not yet been established; it might be true, but it had not been established. But he did venture to think that this was not the only fact bearing upon the question of the construction or the design of machines for parallel running. In the first place they knew perfectly well that machines would not run well in parallel if they had weak field magnets, if they had armatures that, with the output that the machine was designed for, would perturb or interfere with the magnetism of the field in any serious way. Further, they knew that they did not get easy working between two alternators of distinctly different types. In this case, if the two alternators were so designed, whether in the placing of their coils, or the shape of their pole-pieces, or the relative positions of coil and pole-pieces, so that the curves of their induction were widely different, one giving a form nearly like a sine curve, and the other giving a curve like a saw-tooth curve, they would not run in parallel. These were points that really were known, and bore largely on the question of design. Further, he would like to point out that they sometimes spoke of the self-induction in the armature, and of the reaction of the armature, as though

they were the same sort of thing. There was no doubt whatever that an armature which had no iron in it, or in close proximity to it, would have less self-induction and armature reaction than an armature that had much iron in it, and that iron in close proximity to the coils. But they might have an armature which had much self-induction without necessarily very much armature reaction. It depended upon how the iron was disposed near the armature coils with respect to the approach to the polar parts, and the thing which was disastrous in the design of an alternator for these purposes was the putting of iron into the armature in such a way that the iron acted violently on the magnetism, and pulled it about so that the field became an unsteady one. All this, of course, was contained in those wonderful equations on the action of alternate-current machines which Dr. Hopkinson published about 1884. He (Prof. Thompson) was perfectly well aware that the whole theory of alternate working and parallel running could be dug up from those equations. But it was more to the point if they inquired what was the physical action which went on and made it easy or difficult for two machines to run in parallel when they were placed on the same circuit; and the physical effect was really easy to follow out if described by means of a diagram. If they took one of the ordinary types of alternator, say, for example, the Westinghouse (see diagram). Suppose the armature core to be rotating right-endedly, and they had the wires on the outside, the tendency would be to generate currents which would come toward them as the wire was passing the S pole, and to go away from them as the wire was passing the N pole. That was to say, the electromotive forces, everything being supposed to be symmetrical, would be at their maxima in those coils, and would die away to nothing exactly half-way between the poles. Suppose they had two such machines, exactly alike in phase with one another. Their electromotive forces were at a maximum at that particular instant, and if there was no lag in the current, no self-induction, they would have the currents also at a maximum at that particular point. Now, suppose they had those two machines coupled together in parallel, the electromotive forces were equal, if other things were equal, and there was no tendency for one machine to send a current through the other one either way. Now, suppose one was a little

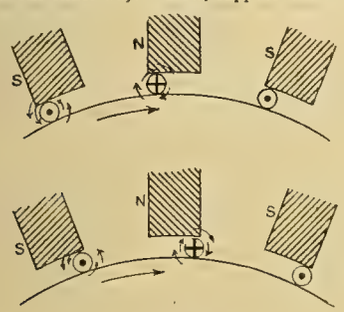


FIG. 2. ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.

behind and the other a little ahead, then the electromotive forces would not necessarily be equal. The consequence would be that the current produced by the two through one another, they would have a load thrown on the leading machine tending to bring it back, and a load tending to bring up the lagging machine. But now suppose that the current in the wires was capable, by reason of the disposition of the iron or anything else, of producing considerable reaction. Now for the receding current, the tendency was to exercise a magnetizing force around it which would strengthen the field in front of it, and weaken it behind. As a matter of fact, the question of strengthening the field in front of it, or weakening the field behind it, strengthening the field as a whole, depended upon whether the strengthening or weakening was a maximum when the coil was in front of the pole of the alternator or not. If the maximum was reached when the wire was behind the middle position, it considerably strengthened the field, but if the maximum occurred when the wire was in front of the middle position it would weaken the field. The one that was ahead of the other would weaken its field, while the other one would strengthen its field. These two reactions, the one of strengthening, the other of weakening, precisely tended to defeat the tendency of the two machines to get back into parallel; that was say, the back armature reaction would of itself tend to prevent the synchronizm to parallel.

J. SWINBURNE said the first thing that struck him on reading the paper was not a purely electrical question, but a commercial one, and that was, what was this power going to cost? What was it going to be sold at, who wanted it, and what were they going to do with it? The cost of the power was not given in the paper. In time it must become public property, and he could not be asking Prof. Forbes any secret, because villages and cities were being built and factories started, and he hardly imagined the cute Yankee was ready to build villages and start factories without knowing what the power was going to cost. This was rather a curious question, and a rather surprising one when they went into it. In most industries the power used was quite a small proportion of the cost of running a factory, whatever it might be. In others, of course, it was a very large proportion. But in such cases, for instance, as flour milling, the cost of power was really a very small proportion, and it would hardly pay to remove a flour mill to a place where power could be had cheap, from a place where labor was cheap. In other cases, such as tearing up wood pulp, of course the cost of power was a much more serious matter. But in dealing with very large power plants it generally came out, unless the load factor was very good indeed, that the cost of coal was not such a serious item as they might expect. Some time ago he worked out a scheme for transmitting power from the Midlands to London, and he found it was very largely a matter of interest, for he found that the interest upon capital was so enormous when compared with the cost of coal that the cost of coal was hardly a factor to be considered at all. There was also another important question in connection with this. They wanted to know who was going to use the power. The problem was entirely different according to whether they wanted to supply small users who required one-tenth of a horse power, or to run printing machines in a district like Fetter-lane, with 2 or 3 horse power, or to drive aluminium works, where they would want hundreds or thousands of horse power. The difficulty with medium powers was to start the motors. That did not come in with large powers; it was a small detail then. Referring to the extra output from a double current, there was something in that undoubtedly, and as a matter of interest he would like to mention that the question of the transmission of power for long distances by means of double alternating current was really before electrical engineers as early as 1887. He had nothing to do with it himself, so he had all the more pleasure in mentioning that at Messrs. Crompton's they had an inquiry for a large power transmission in Australia, and they discussed a method and decided that it should be alternating. R. B. Rogers, then his (Mr. Swinburne's) assistant, suggested that the right way to do it was by double current, winding the armature all over with wire. In fairness to Mr. Tesla and others he must say that he did not think Mr. Rogers realized that this double-current plant would be self-starting, but he quite realized other advantages. But the extra output, which was one of the features mentioned by Mr. Rogers, was a little illusory when they dealt with very large machines. The next thing he ought to remark was the very high infrequency which Prof. Forbes used, an infrequency of 0.04 second per period. He would like to add to what Mr. Mordey and others had said about transformers. Everybody who had done much practical designing would wish to protest against the large amount of general statement in the paper, "all other things being equal," and so on. The whole gist of the matter was in the "all other things being equal." In making a radical alteration such as that the whole comparison turned on the "other things." He protested also against the introduction into a scientific paper of "well known facts." Whenever an author said a thing was a well known fact he was sure to be wrong. As to the flickering of lights, one rather important point ought to be threshed out. Helmholtz was the first, he believed, to investigate the frequency which worried the eye; whether Helmholtz quoted or investigated he was not sure. Helmholtz was concerned with the frequency that worried the ear, and went on from that to the frequency that worried the eye, which he found to be a frequency of 25. It must be borne in mind that the frequency of the flickering in the lamp was always double the frequency of the current, so that would mean, according to Helmholtz, that the eye would stand an alternate current frequency of 12½. It was very curious that Helmholtz's and Forbes' results did not agree. Prof. Forbes observed a flickering at a frequency of 48, or a frequency in the lamp of 96, whereas Helmholtz said the point of limit was 25, so that there was a very large discrepancy between the observations of electrical engineers and the observations of Helmholtz. As to capacity, Prof. Forbes took a great deal of trouble to eliminate capacity from his system. He (Mr. Swinburne) could not help thinking he was wrong there. As soon as Prof. Forbes had in all those triple and double current motors he would find he had a whole lot of consuming devices on his circuit to take up lagging current. Capacity in the mains was very much like putting a redressed circuit round the field magnets. Mr. Crompton and he went into the question of frequency some years ago, and they advocated about the same frequency as Prof. Forbes—about 20. But on looking into the matter they found they were wrong. In the first place, the transformers came out outrageous. In the second place, a point which Prof. Forbes had not mentioned, there was the heating of the field magnets. If they were going to use very low frequency their pole-pieces would be very broad; the peripheral angle covered was large, and if the pole-pieces were not laminated they would get very hot. If they were laminated in the direction of movement they got over the difficulty of heating due to the Foucault currents in it, but they did not get over the difficulty of the enormous hysteresis loss, and he was not sure that this was not going to be a serious difficulty.

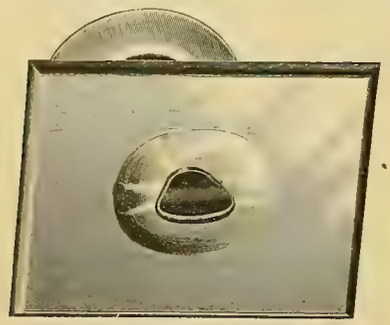
S. F. WALKER said with reference to the winking of incandescent lamps, if they used thick filaments they could make the frequency as little as they pleased. He would like to know what the cost of the culvert which Prof. Forbes described was going to be. It appeared to him that town distribution would have to come to that. At present they buried their cables, and they could not be certain what was going to happen to them. Sooner or later faults would be generated; experience in connection with telegraph lines would bear that out. Therefore, he felt confident that sooner or later subways would have to be made for town work, and the conductors would have to be carried so that a man could walk upright and examine them. Of course, the subways might be used for a good many other things. The only question was one of cost, and it was important to know what that would be. The revolving parts in Prof. Forbes's dynamos were very heavy, and the speed seemed to him to be high. He had followed the designs for the bearings and so on very carefully. They could provide for the speed, for the centrifugal force, and the twisting strain on the spindle, which was a most important matter, but there was a big difficulty when they came to provide a steel spindle which was very large, as it would have to be to stand the enormous twisting strain; they could never be quite certain what they got inside. He believed he was correct in saying that in this country, at any rate, all machines which had such heavy moving masses as this revolved at a very much lower speed, something like one-tenth.

MR. FERRANTI said it was well known that dynamo contractors and designers from all the world over had submitted plans to the Niagara company. It seemed to him that it would be very hard to design a dynamo which was not in every way the best from the knowledge which the gentlemen of the Cataract Construction company had had put before them. There were, however, several important features in which the dynamo proposed was novel. One of them was the method of insulating the coils. He had not heard of any other public proposition except that of Prof. Forbes for doing it in that way. It might be interesting to know that in the provisional specification of a patent he (Mr. Ferranti) had abandoned, occurred a passage describing a very similar arrangement. He let that drop, and he thought wisely so. He had had the pleasure lately, even since the last discussion, as well as before the paper was read, of going round some of the works on the Continent, much as Prof. Forbes and the other engineers of the Cataract Construction company had done. Although he thoroughly disagreed with the general design of the machine, he recognized some details of value in it, but these were embodied in the designs sent in by C. E. L. Brown, of Baden, perhaps the man who had done most towards high-pressure work and long-distance transmission. With regard to the cooling of the bearings, it was a very general practice amongst English and Continential engineers to circulate water continually in the jacket round the bearing, which of course was preferable to throwing water on from a hose according to marine practice, but in this case he should say it would be very effective if water were always left on. There should surely be enough water at Niagara to make this possible. He considered the exciting a large plant like that in series was anything but the best arragement; he believed the old parallel method of exciting had many points in its favor. The question of transforming up was in practice a very awkward one. It led to many objectionable results, and was especially bad where it was combined with other dynamos working direct on the circuit at high pressure. He believed it was contemplated to make those dynamos of higher pressure than 20,000 volts; then, he supposed, the old ones would have to be rewound, remodelled, or worked on this objectionable plan. There was, he thought, a very great difference, which might not appear at first sight, between designing dynamos and building them; in fact, a thing which one made one's ordinary daily business, was very different from getting together a collection of all the information which was available in the world, and, then, without any previous knowledge of dynamo design, and especially building, and more especially running, to design a machine which was hoped to fulfill great expectations. With regard to the next point, that of the construction of the line and the voltage to be used, as he understood it, it was proposed to use an electromotive force of 20,000 volts on the assumption that, as at Deptford, there had been used an electromotive force of 10,000 volts; 10,000 volts with one pole to earth, so the safety would be equally great with 20,000 volts and both poles insulated. He thought this was a great fallacy. If they had two cables, both insulated from earth and charged in this way, it was exceedingly unstable and dangerous. If they adopted the safest method of conveying electricity, namely, by concentric cables, then the outer conductor took the same potential as that of the earth. If the two cables were separate they were liable by any accident which might occur in practice to have one put to earth. Then they would have a reversal of strains, the whole theory of 20,000 volts being as easy as 10,000 being upset, and they would have conditions which they had not provided for. Taking this pressure of 20,000 volts, the question was how to insulate it. He read in the paper that a subway had been partly built to carry the cables. The first impression upon his mind, and also the last after carefully considering it, was that the subway would be a very hot place; 10,000 volts was quite alarming enough when it got out of control; 20,000 with big horse power at the back would be thought, be worse. He thought it was quite possible if any fault did occur in the subway it would cause a very serious state of affairs in the whole of that subway, or, at any rate, through a consderable portion of it, and it would probably lead to the complete breakdown of the system. Next they had the question of periodicity. He could not agree with the periodicity of 16⅔ per second, or even with a periodicity of 25. He was sure there must be a considerable amount of lighting to be done. Why should the lighting be sacrificed? Was there going to be a proportionate gain in the general working of the system by using such a low periodicity? He did not think there would be. He believed the system adopted by Ganz at Buda-Pesth was a more satisfactory one to work at, somewhere about 40. It certainly rendered both arc and incandescent lighting possible, and was somewhere about the happy medium. With regard to the higher periodicity which they had heard spoken of in connection with this Paper, there were enormous difficulties in working with it. It had been spoken of as though it really was not an important thing; but there were very serious effects. In the first place, the capacity effects were much worse where they had to deal with capacity at this high periodicity, and what was much worse than that again was the magnetic retardation due to the field excited round its conductors. This would be alluded to fully in a paper shortly to be read, and he would not further touch upon it, except to say that it was a very grave difficulty. He ventured, however, to say that so high a periodicity as 100, or even 86, as at Deptford, would be fatal to an economical working of the system. They came now to a most interesting question—how was electricity to be transmitted to a very great distance; by what method was it going to be done? Was it going to be done by alternating currents or by continuous current? He must say he did not see the faintest chance of its being done with continuous with the present know-

ledge; but, at the same time, he saw very grave difficulities in the way of doing it by alternating currents.

There was one side of the question which he thought was much more important to the Institution than the periodicity, or the electromotive or the design of the dynamo. It was the general principle upon which the Cataract Construction company had obtained its information. They proceeded in an exceedingly clever way. They formed a Commission, asked the greatest scientists of the day to join them, got a room at the City and Guilds Institute at South Kensington, and gave the Commission power to offer prizes, very small ones, and used other means, in fact any means, by which they could draw and collect information. He had had the pleasure of meeting, some of the people who had sent in specifications. He himself did not send any. Various schemes were sent in. There were those great scientists, men they would not think of questioning, to give the thing perfect legality, and everybody thought it was a good thing. The information was not sent in by amateurs, but by people who had to make their living by building dynamos or some such articles. One firm spent at least £1,000 in doing it, and they might take it that that money did not represent the whole cost nor the value of the brains of those able men who had been engaged in working out a scheme. Nothing sufficiently satisfactory having been obtained, what was the next step? The engineers of the company were sent round to the different works on the Continent to gain information, the company knowing full well all the time that that information was not going to be used to the benefit of those who gave it, or be adequately recompensed. It was upon the information so obtained that the designs and schemes which had been put before the Institution had been got out; it was upon the work of the world, the electrical world, unrecompensed, that the undertaking would be carried out at Niagara. He did not blame Prof. Forbes, but it had been beautifully worked out by the company, and nearly everybody had fallen into the trap.

ALEXANDER SIEMENS said it was only right to the commission who asked for the tenders that he should put the matter from a different point of view from that represented by Mr. Ferranti. He had not the conditions upon which the tenders were given. He (Mr. Siemens) had the pleasure at the time of speaking to the president of the commission, who explained to him that the conditions were to be that the different competitors were to send in detailed designs, and if successful, superintend the construction of the machinery in America for a commis-



IONA FLUSH SWITCH.

sion of 2½ per cent. or 5 per cent., he forgot which. Under those conditions they competed, but did not send detailed designs, and, as a matter of course, were excluded from the prizes. But he was perfectly certain that nobody who read the conditions under which they tendered could say that it was not from the beginning the intention to construct the whole of the machinery in America. He did not think any question ought to arise about being able to send a current of 20,000 volts through underground cables. He, for one, would be perfectly ready to supply cables that would carry 20,000 volts. Such cables were in daily use at the Frankfurt exhibition, having been supplied by his firm for connecting the transformers in the machinery hall to those in the main annex; the normal working pressure was 20,000 volts, the cables having previously been tested to 40,000 volts. Another point which had been insisted upon was that it was quite out of the question to think that a continuous current could serve for such a transmission. Well, he was not so sure about that. Their own project for the Niagara transmission was for continuous current, using machines and motors in series. He was not sure that the Cataract Construction company would not be converted to the continuous current before they had done.

COMMUNICATION.

The Telephone Situation.

To the Editor of the WESTERN ELECTRICIAN:

The ignorance of the general public upon the telephone situation is proverbial; and, with the end in view of enlightening the misinformed, I pen this brief article.

We will start with the first patent awarded to A. Graham Bell, on March 7, 1876, of which the legality was disputed by Drawbaugh, Cushman, Dolbear and others. This patent (the basic patent, as it has been termed, because the United States Supreme Court so interpreted it as to cover the principle of telephony, thereby preventing any one else from sending speech-vibrations by means of electric force) expired, by limitation, on March 7, 1893; but Mr. Bell had another patent, that of January 30, 1877, known as a combination patent, and under this latter patent the Bell people have kept out other inventors, and will keep them out until January 30th instant. In 1877 both Emile Berliner and Thomas A. Edison put in applications for carbon-microphone telephone transmitters, and, the Bell people having bought the rights of both these inventors, kept these two patents interfering with each other until 1891 and 1892, finally succeeding in getting a patent on Berliner's claim in 1891, and on Edison's claim in 1892. Edison's patent, the Patent Office authorities admit, is of no consequence whatever, and, as to the Berliner claim, the United States government has brought suit against the Bell company to vacate this patent, not only on the ground of fraud, but also upon the ground that the Patent Office laws were not complied with. That the government will win this suit no well-informed lawyer doubts, because a valuable thing has been substituted for a worthless one, as the citations, expert testimony and affidavits now in the hands of the government attorney prove. According to the sworn testimony now in, nothing of the original application remains but the signature of Berliner and his witnesses.

The Bell company claims the 1877 patents of Bell, the 1891 patent of Berliner and the 1892 patent of Edison—nothing more—and, with these three patents—one expiring the 30th of this month, another already declared worthless and a suit on the part of the government to have the third declared null and void on account of fraud and non-compliance with the laws—this boastful, oppressive organization is again trying its level best to frighten Tom, Dick and Harry into the belief that it still owns the earth, telephonically speaking!

R. D'UNGER, M. D.

Chicago, January 6, 1893.

Electricity at the World's Fair.

Assistant Chief Hornsby, of the department of electricity, and Electrical Engineer Pierce are both hard at work on their reports, which will be out in a few weeks.

One of the curious things at Jackson Park is the sight of the Intramural railway hauling itself away. The road has been transformed into a freight line for this purpose, and flat cars drawn by an electric motor car rumble over the elevated roadway. The demolition of the superstructure of one of the most famous railroads in the world began at its north loop a few days ago. As fast as the timbers and rails are taken apart they are hoisted on to the flat cars and hauled to the power house. One of the motor cars has been fitted up with an inclosed cab for the motorman, and will do duty as a freight motor until the superstructure is too short for a haul.

Carl Rohl-Smith's statue of Benjamin Franklin at the south entrance to electricity building will be shipped to Philadelphia, for it has been given to that city by the directors.

"Novak" Lamp Manufacturers Enjoined.

The owners of the Edison lamp patents are not relaxing their efforts to secure a monopoly of the market. A suit was recently begun against the Waring Electric company for infringement before Judge Shipman in the United States Circuit Court for Connecticut, and on Monday the judge handed down a decision granting a preliminary injunction restraining the defendant from manufacturing the "Novak" lamp. It was contended on the part of the defendant that this lamp did not infringe the Edison patent, inasmuch as gas was contained in the bulb, whereas in the Edison lamp the filament is rendered incandescent in a nearly perfect vacuum. In his decision, however, Judge Shipman held that the patent could not be evaded by the introduction of gas in the lamp, and that the "Novak" lamp was therefore an infringement on the Edison claim.

An Attractive Issue.

Although somewhat belated, the last issue of the *Electrical World*—the first in the new form of reduced pages—was of conspicuous excellence and one reflecting credit on all taking part in the work of producing it. The *World* in its new shape was awaited with much interest by the electrical fraternity, and the expressions of praise were many and cordial. The WESTERN ELECTRICIAN extends its congratulations on the 100-page issue. An interesting feature of the paper was a comparison of the advertisements published in the *World*, *Engineer* and *Review*, much to the advantages of the first named.

Iona Flush Switch.

In the accompanying cut is illustrated the flush switch made by the Iona Manufacturing company, Boston, which is one of its most popular specialties. This switch is particularly convenient to wire and makes a neat finished appearance when put in the wall, there being no screws in sight. The mechanism is the well-known snap and ratchet movement, simple and reliable, and the switch is furnished in single or double pole, singly or with several switches on the same face plate, in nickel plate or fancy colors to match interior decorations.

An electric railway system will probably be established between Windsor and Amherstburg, Ont.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 8.—Another telephone central office was opened January 3d in the new building of the Metropolitan Telephone & Telegraph company, at 95 Broad street. By this addition to the company's plant the section bounded by Broadway, Wall street, the Battery and the East river will be served, and the Cortlandt street station, overcrowded with the wires of 5,000 subscribers, will be greatly relieved. Already 1,100 subscribers have been connected with the new office, which has an ultimate capacity of 3,000. The most modern telephone appliances have been utilized in this plant. The wires are brought into the building through the basement in lead-covered cables. At the ends of the cables the conductors are joined to lightning arresters. Various devices are introduced to facilitate and quicken service, such as self-restoring indicators, which return automatically to their normal position; apparatus for ringing subscribers' bells, for testing lines, for locating troubles, and for insuring ready supervision of work. There are now eight exchanges in the city, with accommodation for 15,000 subscribers; more than 9,600 subscribers' stations, 800 private line stations and 30,000 miles of underground wire. About 60 per cent. of the subscribers now have metallic lines and equipment. With a metallic circuit line and equipment line a subscriber may now talk from his desk to upward of 100,000 telephone subscribers in this and other cities. There are between 80,000 and 90,000 conversations by telephone each day in this city. The average number of times the telephone is used daily by each subscriber is sixteen. Many busy subscribers telephone from 100 to 200 times a day. For the entire system there are 400 operators, nearly all young women, who each connect subscribers' wires about 400 times a day. About 250 operators are on duty at the same time. The working force to maintain the telephone service consists of about 1,000 persons, an average of one employe to every nine subscribers.

The following is a summary of the work performed in the bureau of police telegraph for the year 1893, as given out the first of the year by Superintendent Brennan:

Total number of miscellaneous messages transmitted over the police telegraph and telephone lines for police and other departments	113,954
General-alarm messages, comprising general orders of Board of Police, Superintendent of Police, Inspectors, etc	224,364
Dead animals reported over wires	35,000

During the year eighty miles of electrical conductors for the police telegraph and telephone systems were put under ground, principally below Houston street, and fifteen miles of police wires were transferred from pole lines, so as to allow the board of electrical control to remove poles. The headquarters are now connected by telephones with the First, Second, Third, Fourth, Fifth, Sixth, Eighth, Ninth, Tenth, Nineteenth, Thirty-sixth (police boat), and Thirty-seventh Precinct Stations, Pier A and Pier 41 North river, Tombs police court, and the branch of the detective bureau at 13 Wall street. It is intended to equip all the other police stations, police courts and public hospitals with telephones connecting direct with police headquarters with underground wiring.

The rapid transit commission met January 1st. The session was a secret one. Since the adoption of the independent elevated road plan four surveying parties have been at work obtaining figures on grades and angles and other data for both the east and west side lines, and it was upon the preliminary report of these parties that Mr. Bogart, the commission's engineer, talked most of the time at the meeting. A number of serious difficulties have been encountered by the surveyors and engineers. Three points in particular will require a great amount of study. One of these difficulties is found at the southwest corner of Central Park, where Fifty-ninth street crosses Eighth avenue and the Boulevard. Here is located the circle in which stands the big Columbus monument not long ago erected by the Italian residents of the city, to which they presented it. The location of this handsome memorial is such that the engineer of the commission is at his wits' end to devise a means to pass it. Either it will have to be removed to some other near-by suitable spot or the most delicate of engineering will be required to construct an "L" road around it from Broadway into the Boulevard. A great deal of study was given the problem at the meeting without any definite conclusion being reached. On the east side route exactly the same trouble presents itself. In this case the big statue of Washington that stands in the plaza at the southeast corner of Union Square is in the way. Aside from these two points, Engineer Bogart will be puzzled in planning the grades of the west side line over the Manhattanville hills, where there are very heavy

grades, and also in the descent from the elevated structure at Thirty-second street into the Fourth avenue tunnel at Thirty-fourth street. This latter problem is further complicated by rights pertaining to the Fourth avenue surface line, which the counsel of the commission is busy studying over. Another meeting of the commission will be held this week.

The real estate men of Buffalo are considering plans for celebrating on a large scale the inauguration of the use of the Niagara Falls electric power in Buffalo. The plan most favored is to issue letters of invitation to President Cleveland and his cabinet, senators and congressmen, governors of states and other high officials, all the eminent electricians of the world, and representatives of the press from everywhere. The wire conveying the current is to be connected with one of the large manufacturing plants near the city line and the machinery set in motion by the touching of a button.

The Executive Board of District Assembly No. 75 of the Knights of Labor, which includes all the surface railroad employes in Brooklyn, has decided that the men should not strike for higher wages at present. In view of the present disagreement this action is significant.

The highway commissioners of Flatlands, L. I., have granted an application for a franchise to the Brooklyn, Bergen Beach & Canarsie Railroad company to build eighteen miles of railroad in the town. The latter is to be an electric trolley road, beginning at Flatbush avenue, at the terminus of the system of the BrooklynCity Railroad company. The line will extend to Bergen Beach, with a branch across country to the Canarsie shore. An electric plant to cost $30,000 is to be erected at Flatbush avenue and Kings Highway. By the terms of the contract work is to begin immediately, and it is expected that the road will be in operation early in the summer. The company is incorporated with a capital stock of $200,000; Percy G. Williams is president, and Thomas Adams, Jr., treasurer.

Suit has been begun in the New Jersey Supreme Court by Thomas A. Edison against the Edison United Phonograph company for $1,000,000 damages, alleged to have been done him by the defendants through the sale of phonographs in this country and abroad. The Edison United Phonograph company has also begun suit against Edison, the Edison Phonograph works and the North American Phonograph company for $400,000 damages, alleged to have been done to the plaintiff by the sale of phonographs in foreign countries.

Joseph G. Hillam, who has figured in rapid transit matters as the advocate for the Reno double-decked tunnel system, claims he has secured the approval of one member of the commission on a private plan of his own. It is his intention to submit it to the commission at the next meeting when he claims he will also present the written assurances of capitalists who stand ready to provide the means of building such a road as he proposes. It is the plan of Mr. Hillam to use two shields for a tunnel, moving one ahead of the other, so as to displace as little soil as possible at a time, and to dig two tunnels, one under the other, with two feet or more of rock or soil between them. The cost of each tunnel was estimated at $ 5,000,000, but until the upper one earned a paying income, he would not dig the other. Means of deadening sound, and of providing ventilation it is claimed have also been worked out. The exhaustive details have evidently been carefully prepared. The electrical features of the plan are of interest. It is intended to operate the route by electricity, and for local or way trains to have the first and last cars constructed a trifle longer than the other cars, in order to provide room for the man in charge of the lever regulating the running of the train. By thus placing the motors on the four axles of the first and last cars, the driving power would be more evenly distributed, and a train would get its speed quicker. A further advantage in this method would be that it does away with the building of loop lines to make the return trip, or shunting of motor engines, as the motorman will simply have to walk to the other end of the train, and start on the return journey, a self-acting spring switch turning the train on to the down or up line, as the case may be. As numerous cross-overs would be arranged along the route, this would effect a saving in time also. For the express trains two motor engines of 150 horse power each, one at each end of the train would be used. It is intended that the cars will be brilliantly lighted with electricity, painted and decorated in light colors. In addition, the tunnels will be lighted throughout with electricity, fed with a separate wire; thus in case of any accident to the car lights, passengers would not be in darkness. In order to insure steady, even, and noiseless running of the trains, it is intended to use heavy steel rails, 100 pounds per yard, and weld the joints together, making a continuous rail, in fact. The ties will also be laid in concrete. Ventilation is provided for by fixing electric fans in air shafts conducted from the sides of the tunnels and carried horizontally across the street, and thence to the surface. The fans will be placed midway between stations, and so arranged, by making every alternate fan to operate in opposite directions, that one fan will be drawing out foul air, while the other is forcing in pure air at the rate of 32,000 cubic feet a minute for each fan. The discussion of this plan will doubtless be of much interest to electrical men. W. F. O.

PERSONAL.

A. Mitchell Hall, general manager of the C. & C. Electric company, was in Chicago last week looking after the interests of his firm. He reports that the new works are progressing satisfactorily and that the company will manufacture a full line of directly connected multipolar generators and also a complete line of alternators.

John L. Martin, for many years in charge of the central station lighting department of the Chicago office of the Thomson-Houston and General Electric companies, has resigned and has been succeeded by J. W. Johnson, formerly at the head of the isolated lighting department, the two departments having been combined. Mr. Martin will assume a connection with the new National Electric company of Eau Claire.

ELECTRIC LIGHTING.

Greenville, Ind., has granted a franchise for an electric lighting plant.

An electric light plant will be set up in the Cornelius cotton mills at Davidson, N. C.

The recently burned electric light plant, Leicester, Mass., will probably be rebuilt.

An electric lighting system will be located in J. H. Crowley's weaving mill at Charlotte, N. C.

The Niles, O., Electric Light & Power company has offered to sell its plant to the city. The matter is under consideration.

A station having a capacity of 60 arcs and 750 incandescents has been established at Sullivan, Ind. Western Electric machinery is used.

The Syracuse, N. Y., Steam Heat & Power company has applied to the council for a franchise permitting it to supply electric currents for light and power.

It is said electric lighting is now about to be introduced on some of the Indian railways. Preparation of plans for lighting the Arkonam railway station by electricity are being considered.

The contract between Massilon, O., and the Massilon Electic Light company, expires next October, and a movement is being agitated to erect a municipal plant at an estimated cost of $40,000.

The Milwaukee Arc Light company reports that central station business is improving in that city. It has recently ordered a 50 light machine and 50 lamps from the Western Electric company, and says that nearly all of the latter have been already placed.

The electric lighting plant on the recently launched twin-screw lake steamer Northwest is said to be the most extensive of any vessel now afloat. The plant is located on the lower deck and aft of the emigrants' quarters. The Campania, the new Cunard liner, has 1,200 lights but the capacity of the Northwest's plant is 1,300 lamps.

The residents of Arima, in Hyogo Prefecture, a favorite resort of the foreign population of Kobe, Japan, and celebrated for its hot mineral springs, are endeavoring to promote an electric light company. There is an abundance of water power available for this purpose at the Tsuzumi waterfall.

The Lousiana, Mo., Electric light company was absorbed on December 21st by the Carbon Light company of that city, which has hitherto been operating a combined gas and electric lighting plant. The officers of the Carbon Light company are: President, John H. Lucas; secretary, William T. Johnson; superintendent, B. S. Reynolds.

Preparations are being made to carry out a somewhat extraordinary scheme of electric lighting in Antwerp, Belgium. The plan is to distribute water power from steam pumping stations at a high pressure to small sub-stations. Turbines will be placed in the sub-stations and will be driven by the water power thus obtained. Distribution is to be on the two-wire low pressure system.

The contract for furnishing arc lights in Philadelphia for the ensuing year have been awarded as follows: Kensington Electric company, 156 lights, at 45 cents per light per night, $25,627; Brush Electric Light company, 1,356 lights at 39 cents per light per night, $193,026.60; 217 lights at 38 cents, $30,097.90; Powelton Electric company, 300 lights at 45 cents, $40,275; Manufacturers' Electric company, 38 lights at 45 cents, $6,241.50; 165 at 50 cents, $30,112.50; Wissahickon Electric Light company, 93 lights at 50 cents, $16,972.50; Suburban Electric Light company, 217 lights at 55 cents, $43,562.75; Germantown Electric Light company, 116 lights at 52½ cents, $22 228.50; Southern Electric Light & Power company, 303 lights at 45 cents, $49,767.75; 202 lights at 47½ cents, $35,031.75; 54 lights at 38 cents, $7,489.80; Diamond Electric company, 87 lights at 45 cents, $14,289.75; 50 lights at 50 cents, $9,125 and 73 lights at 40 cents, $10,658. Altogether there are to be furnished 3,427 lights at a cost of $543.502 30. The average cost per light per night is 45 45 cents. The appropriation made by councils is $549 376.00

ELECTRIC RAILWAYS.

It is said that Arkville, N. Y., and Margaretville will be connected by an electric road and both villages lighted by electric light.

The power house of the Altoona, Pa., & Logan Valley Electric Railway company burned week before last. The loss is $25,000.

The Hayward's Electric Railway company, Oakland, Cal., has asked ior a franchise on Water street and also for loop privileges.

The Central railway, New Britain, Conn., has been given rights to construct an electric line between Berlin and New Britain.

It is intended to connect Valley Junction, a suburb of Des Moines, Ia., with the Des Moines Street Railway company by an electric line.

Petitions are being actively circulated in Somerville, Mass., for extensions to the electric lines. It is said the improvement is likely to be made.

The Pittsburg & Mansfield Railway company, Pittsburg, Pa., wants a franchise for a double track electric road, partly surface and partly elevated.

The Yuma, Cal., common council has granted A. B. Smith franchises for an electric railway. An electric light system is also contemplated in Yuma.

A franchise has been given to the Citizen Railway company, and an electric line will be built from Indianapolis, Ind., to Haughville and West Indianapolis.

The Mt. Vernon Electric Railway company, Alexandria Va., has been given rights of extension of its lines on several new streets and outside of the corporation line.

It is stated that work on the electric railway to connect Junction City, Kan., and Fort Riley will be commenced in a short time. Part of the material is now on the way to this place.

The Canadian General Electric company and the industrial and executive committees of the city council of Belleville, Ont., are considering proposition for an electric railway in the town.

The Brooklyn City Railroad company has bought the Flushing & College Point electric railway, and assumed control January 1st. The road will be materially extended and improved.

The street railway companies of St. Louis, Mo., have signified their willingness to furnish the current for light for the fall festivities to be repeated next fall. Decorative car lighting will also be a feature.

It is reported that the People's Electric company, of Sandusky, O., is to extend its system and put in an express and baggage service, and that $15,000 worth of bonds will be issued immediately.

The project of an electric line from Cleveland, O., to Chardon and Burton, in Geauga county, is again being agitated. The line will be used both for freight and passengers it is said. Surveys have been made.

The South St. Louis Electric Railway company has secured a number of valuable options on real estate and is about to build an electric railway out Loughborough avenue to Gravois road. The line is said to be well backed.

It is reported in the City of Mexico, Mexico, that a United States syndicate has bought the railway line from Guadalajara to San Pedro, and that it will be extended both north and west, and changed from horses to electricity.

The electric railway between Cleveland and Berea, O., will have a full complement of rolling stock before next summer. The Ford-Washburn Storelectro company will attempt to reduce the weight of the new battery cars to eight tons, on all other respects the system is said to be giving good satisfaction to the operating company.

The Conduit Construction company, of New York city, has been organized by Thomas C. Buck, C. W. Keep and Julian Meyers, of New York city; Robert L. Keen, of Montclair, N. J., and John J. Green, of Boonton, N. J. The company will build electric conduits in connection with electric railways, and introduce the conduit system of underground trolley.

The Philadelphia Traction company has contracted with the Westinghouse Electric & Manufacturing company for electrical machinery of 11,250 horse power for the operation of its electric street railways in Philadelphia. This large contract represents over $300,000. The machines consist of six 1,500 horse power generators and three 750 horse power generators.

The opening of the Thirteenth and Fifteenth streets trolley line in Philadelphia two weeks ago added fifteen and one-half miles to the electric system of the city. This mileage, however, is small in comparison with that which will be electrically operated within the year. According to the reports of the officials of the companies, 200 miles of eleciric railway will be completed before next winter.

An ordinance has been introduced in the St. Louis, Mo., council granting a franchise to the National Unicycle Electric Railway Construction company for the construction of an elevated railway from North Third street, near Round Top Market, through Forest Park to the city limits. The franchise is to continue 50 years, and the first 10 years the

company is to pay the city $3,000 per annum, and the succeeding 40 years $5,000.

A contract has been closed for the construction, within the coming year, of an electric railway between Pottstown, Pa., and Boyertown, a distance of seven miles. The line is to be known as the Pottstown, Boyertown & Reading railway. The officers are: President, James B. Craighead, Philadelphia; secretary, Mahlon G. Taylor, Pottstown; directors, J. M. Zook, Philadelphia; Charles K. Spatz, Boyertown; James B. Craighead and M. G. Taylor. It is probable that the line will also be extended to Reading. C. F. Eberle, Philadelphia, has the contract for building the road.

The International Tramways Congress, which met last autumn at Buda-Pesth, passed the following resolution bearing upon electric tramways: "The electric tramways with direct current from a central station has given satisfaction on several lines on the Continent, now in operation, and this applies both to tramways with underground and to tramways with overhead conductors. The statistical figures hitherto available are, however, not sufficient to form a definite opinion about the financial aspect. The employment of electricity is, however, in the interest of the public, as not only will a greater speed be obtained, but it will also be possible to carry a larger number of passengers. The congress asserts that in its opinion the electric system of working should, therefore, be recommended to authorities and tramway administrators. The congress further holds that the authorities should endeavor to make it possible for tramway companies to undertake the expense of a change from horse to electric traction by extending the concessions, and permitting the use of overhead conductors."

TRADE NEWS.

The Knapp Electrical Works were removed last week to the new location, 271 and 273 Franklin street, Chicago.

The Sunbeam Incandescent Lamp company, Chicago, announces that the new Sunbeam lamp as now made with luminous vapor is attracting much interest among electrical people, and that it is fulfilling all the claims made for it.

The Beacon Vacuum Pump & Electricial company, Boston, Mass., has reduced the price of its new Beacon incandescent lamps. It now offers to the trade 16 candle power lamps in lots of 1,000 or over at 30 cents, in lots of 500 at 31 cents. The price for smaller quantities is 35 cents. The lamps may be fitted to any socket and range in voltage from 45 to 125. This lamp was placed on the market last summer, and since that time improvements have been made which place it in the front rank of incandescent lamps. The company is now inviting correspondence from those desirous of manufacturing the lamp under license.

The Electric Appliance company, Chicago, reports that the interest manifested in the new Washington arc lamp for alternating and direct current constant potential circuits is becoming very general, and inquiries and orders are coming in from all parts of the country. The success of the new Mogul lamp is also noteworthy. It is said that the orders that the factory is receiving are already taxing its capacity. The Mogul lamp is intended for large interior lighting, such as halls, theaters, churches, etc.; in fact, a number of contracts for this kind of work has already been made. The Electric Appliance company, as western agent for the New York & Ohio company, is carrying a stock of the lamps in Chicago and making large sales.

A short time ago a number of gentlemen of Ottawa, mostly engaged in the electrical business, formed themselves into a club and procured comfortable quarters on Sparks street between O'Connor and Bank streets. The organization is known as the Kerite Club, so called as a compliment to the manufacturers of the wire of that name. Last month the formal opening of the club took place under the most pleasing circumstances. The rooms were decorated with flags, Chinese lanterns and electric light effects. Among the guests present were Senator Clemow, W. Y. Soper, G. Duval, of the Supreme Court; J. E. Hutcheson, F. Leamy, A. Armstrong, W. Lampman and others. The president, George F. Macdonald, delivered a short address upon the objects of the club, expressing the utmost confidence in its future success. Songs and instrumental selections were given during the evening.

The incandescent lamp war continues unabated. The latest note of warfare comes from the Columbia Incandescent Lamp company, of St. Louis, which announces reductions to the following prices: 10, 16 and 20 candle power, 32½ cents; 25 candle power, 35 cents; 32 candle power, 50 cents; 50 candle power, 75 cents; special railway and anchored filament types, 37½ cents. Net prices are given in each case, and the rates are made for barrel lots. For smaller quantities 2½ cents each will be added. The company states that the same high grade of the Columbia lamp will be maintained, and that it is enabled to make this reduction by reason of the support which has been given to it by users of incandescent lamps throughout the United States during the last year. This has enabled the company to largely increase its manufacturing facilities and to add additional machinery, which has reduced the cost.

BUSINESS.

The Western Electric company has sold two 45 kilowatt and one 10½ kilowatt 110 volt dynamos for use in the Buffalo State Hospital for the Insane.

The Novelty Electric company, of Philadelphia, reports it is having a large call for its insulators, which have been accepted by the Fire Underwriters' boards of New York, Boston, Philadelphia and Chicago. The company is sending samples for inspection to those desiring anything in this line.

For nearly two years the Bryant Electric company, Chicago, has manufactured the well-known Paiste switch. The company is the sole owner of the Paiste switch, and as in all other of its productions, advertises these switches to be of a high grade in quality and workmanship.

George W. Connover, formerly purchasing agent of the Electrical Supply and Ansonia Electric companies, has resigned, and opened an office at 1536 Monadnock building as western manager for the Perkins Electric Switch Manufacturing company of Hartford, Conn. Mr. Connover's long experience in the electrical business, and his wide acquaintance peculiarly adapts him for his new position. The Perkins company will carry a large and complete stock of switches, cut-outs and sockets.

The American Leather Link Belt company, New York, has issued a book descriptive of its product and illustrating the interesting process of its manufacture. The link belt are of particular value for use on dynamos where speed is a disadvantage in using ordinary belts, as the strain often causes hot bearings and great wear on the machinery. With the belt manufactured by this company, the tight side being kept on the bottom, it can be run very slack, causing less heating of the bearings and saving quantities of oil. For quarter turn the link belt also has advantages, as the construction of the belt allows it to conform itself to this and other angles without an uneven strain. In damp places this style of belt shows qualities which are of great value under such conditions.

The C. & C. Electric company expects to occupy its new works at Garwood, N. J., about March 1st. The main building is 500 feet long by 80 feet in width, and contains the main machine shop, light machine shop, winding shop and erecting and assembling shop. A ten-ton electric traveling crane is operated in this building. The three other buildings are used for the following purposes: One building, 72 by 110 feet, for stock room of raw materials; one, 72 by 110 feet, for light winding and testing room, and the third, 50 by 96 feet, for storage and shipping. In addition to these buildings there is a boiler room containing three boilers, with capacity of 300 horse power, an engine room with an engine of 150 horse power, with feed, water heater, etc., to be shortly supplemented by a second engine, direct connected to multipolar dynamos of 150 horse power capacity; a pattern shop, 30 by 48 feet, a polishing shop, 25 by 50 feet, and other rooms. Side tracks are so arranged that cars containing raw materials can be set in, and those containing shipments taken out independently, while an industrial railroad runs into all departments to enable the expeditious handling of light materials without interfering with the use of the crane for the transfer of heavy materials. All shafting and machinery are driven by motors which are supplied with current from the dynamos in the engine room. Much care has been exercised in the grouping of tools and machinery, in order to show the great advantages to be gained from electrical power transmission with a maximum efficiency with minimum investment. To this end such large tools as are in constant use are supplied with individual motors of sufficient capacity to operate them, while the smaller tools, which require a varying amount of power, are grouped together upon short lengths of line shafting with a motor sufficiently large to meet all requirements made upon it, but without the heavy investment in motors necessary if individual motors were provided for each tool with a sufficient capacity to operate each one at full load. The works have a floor surface of about 62,000 square feet, and throughout show a careful consideration of advantages to be gained by concentration of departments, and at the same time an arrangement permitting of growth of these departments without interfering with the most economical conduct of work.

ELECTRICAL PATENTS.

Issued December 26, 1893.

511,328. Method of Electric Commutation and a Fluid Electric Commutator. Charles E. Emery, Brooklyn, N. Y.

Two pipes electrically connected like the brushes of a dynamo are arranged to discharge conducting fluid upon the sections of moving commutator, the fluid may thus be made to take the place of the commutator brushes, and renders possible the use of higher potentials than can be used with ordinary brushes. Heavier currents may also be carried through each pair of fluid brushes than has heretofore been practicable with metallic brushes.

511,341. Cleaning Device for Railway Conduits. John C. Love, Philadelphia, Pa.

511,342. Conduit Railway Trolley. John C. Love, Chicago, Ill.

511,343. Trolley for Conduit Railways. John C. Love, Chicago, Ill.

511,344. Support for Electrical Conductors. John C. Love, Philadelphia, Pa.

511,345. Tension Device for Electric Conductors. John C. Love, Philadelphia, Pa.

511,346. Trolley Bar Carrier for Cars. John C. Love, Philadelphia, Pa.

511,347. Governor for Electric Motors. John Marty, Jr., Cleveland, O.

511,358. Telephone. Barton Pickering, Dayton, O.

511,375. Method of and Means for Compounding Dynamo-electric Machines. Elihu Thomson, Swampscott, Mass.

Iron masses called dead poles are placed opposite those parts of the armature which become polarized by the currents flowing therein. The current thus flowing in the armature, under load, so acts as to produce a field of force in which the armature winding moves, and which will be in proportion to the load on the armature, and will therefore increase the electromotive force or counteract any decrease thereof which might be suffered under load.

511,376. Electric Measuring Instrument. Elihu Thomson, Swampscott, Mass.

The instrument comprises an oscillating horse-shoe magnet, having its poles in close proximity, and a coil traversed by the current to be measured and having an extended flat portion between the magnetic poles.

511,401. Electric Meter. Lucien Brillié, Paris, France.

511,407 Process of Making Resistance Plates. Charles E. Carpenter, Bridgeport, Conn.

511,419. Trolley Wire Crossing. Henry Geise, Philadelphia, Pa.

511,448. Electric Locomotive. John G. McCormick, Louisville, Ky.

511,451. Electric Bell. Augustus J. Oehring, Chicago, Ill.

511,452. Conduit for Electric Railways. Henry D. Oler, Paterson, N. J.

511 456. Telephonic Instrument. Parnell Rabbidge, Sydney, New South Wales.

511,461. Safety Device for Electric Circuits. Charles H. Rudd, Evanston, Ill.

The safety device is designed to afford passage to ground for static charges while preventing leak of dynamo currents. A high resistance shunt is placed around the working circuit, and from its center a high resistance branch extends to ground.

511,462. Fire Alarm Telegraph. Charles H. Rudd, Chicago, Ill.

511,464. Multiple Switchboard System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill.

The circuit connections are such that the individual annunciator of any line, while remaining permanently connected with the line circuit, shall remain inoperative or irresponsive to signaling currents in the circuit during the connection of the line with another telephone line.

511,495. Electric Arc Lamp. Reginald Belfield, London, Eng.

511,503. Electric Measuring Apparatus. Theodore Bruger, Bockenheim, near Frankfort-on-the-Main, Germany.

511 514. Process of and Composition for the Manufacture of Porous Cups for Electrical Batteries. Frank G. Curtis, Philadelphia, Pa.

The cups are manufactured by moistening a suitable clay with water containing carbonate of ammonia in solution, after which the clay is moulded to the proper form and baked.

511,523 Current Regulator for Dynamo-electric Machines. Charles D. Haskins, Brooklyn, N. Y.

The regulator is for constant current arc light machines, and acts by shifting the brushes upon the commutator. An electro-magnet mounted to rotate is revolved by the rotating armature. A revoluble armature is mounted opposite the poles of the magnet and tends to rotate under the pull of the magnet, which pull is normally counterbalanced by a weight. The brush carrier is connected with the armature, and when the current increases the magnet overcomes the constant pull of the weight to shift the brushes to lessen the current, and vice versa.

511,524. Converter System for Electric Railways. Gustaf E. Hesse, Brooklyn, N. Y.

511,527. Automatic Electric Light Extinguisher. George M. Hughes and George T. Reed, Baltimore, Md.

511,547. Electric Wire Covering. Franklin S. Randall, Philadelphia, Pa.

The covering consists of raw cotton in bulk, the cotton being first formed into a yarn and then wrapped about the wire.

511,559. Electrical Transmission of Power. Nikola Tesla, New York, N. Y.

The invention relates to the operation of motors having independent energizing circuits; alternating currents are passed through both of the circuits, the phase in one being retarded to a greater or less extent than in the other.

511,560. System of Electrical Power Transmission. Nikola Tesla, New York, N. Y.

511,652. Cloth Cutting Machine. Arthur K. Thyll, New York, N. Y.

511,570. Rotary Electromagnetic Engine. Henry P. White, Kalamazoo, Mich.

511 589. Telephone System. Frank R. Co'vin, New York, N. Y.

511,611. Insulator. Charles N. Hammond, Boston, Mass.

511,612. Insulator. Charles N. Hammond, Boston, Mass.

511,613. Rosette for Electric Lights. Charles N. Hammond, Boston, Mass.

511,621. Electric Motor Apparatus. William A. Johnston, Arthur W. Browne and John C. Davidson, Prince's Bay, N. Y.

511,627. Electric Railway Switching Mechanism. Charles J. Kintner, New York, N. Y.

511,634. Trolley Base. James L. Mauldin, Cleveland, O.

511,647. Electric Grain Weighing Scale. John Outcalt and David De P. O. Outcalt, Spotswood, N. J.

511,682. Electrolyzing Apparatus. Antoine J. O. Chalandre, Paris, France.

511,720. Fire Guard for Lamp Cords. Edwin E. Angell, Somerville, and Stephen Porter, Boston, Mass.

511,731. Electric Signaling Apparatus. Thomas B. Doolittle, Bridgeport, Conn.

511,742. Electric Cautery Apparatus. James A. Wotton and Earnest A. Bostrom, Atlanta, Ga.

Western Electrician.

EVERY SATURDAY.

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The Armour Institute.

Since the opening of the Armour Institute as a result of the benevolent generosity of Philip D. Armour, the young men and women of Chicago and vicinity who are seeking technical instruction need not go away from home for the benefits of a polytechnic school of the first grade. The need of such an institution has long been felt in Chicago, and an exhaustive discussion on the subject in the Chicago Electric club two years ago attracted much attention. That this need was a very actual and pressing one is shown by the fact that although the school was opened only last year it has already between seven and eight hundred students.

The Armour Institute was founded for the purpose of giving to young men and women the opportunity of securing a liberal education. It is not intended for the poor or the rich, as sections of society, but for all who are earnestly seeking practical education. Realizing the importance of self-reliance as a factor in the development of character, the founder has conditioned his benefactions in such a way as to emphasize both their value and the student's self-respect. Armour Institute is not a free school; but its charges for instruction are in harmony with the idea of helping those who wish to help themselves. Moreover, such liberal provision has been made with regard to free scholarships, which are intended as a recognition of merit and ability, that no deserving young man or woman need forego the privileges of the institute because of straightened circumstances. The scope is very broad and embraces an academic department, including a scientific academy and a technical college, and distinct courses in civil engineering, mechanical engineering, electrical engineering, mining engineering, the domestic arts, library science, art, architecture, music, and kindergarten instruction. All of these departments are not fully organized, but in all especial attention will be paid to practical training without neglecting theoretical instruction. With this in view no pains or expense have been spared to secure the best appliances for the use of the students in class-room, workshop and laboratory, and in this respect few of the technical schools of the country are better equipped, and when consideration is taken of the aim and backing of the institution it is fair to assume that within the next five years the Armour Institute will not be excelled anywhere in instruments and machinery for practical engineering instruction. The faculty, headed by Dr. F. W. Gunsaulus, is able and already large. The institute is housed in a five-story building, shown in Fig. 4, on the corner of Thirty-third street and Armour avenue. The structure is graceful in design, well built and supplied with every convenience. The heating and lighting plant is placed in the one-story extension on Armour avenue.

The department of electricity and electrical engineering is in charge of Prof. W. M. Stine, with T. P. Gaylord as assistant. Prof. Stine is a graduate of Dickinson College, where he took the highest honors in science. He became professor of electrical engineering in Ohio University, from which he came to the Armour Institute. Prof. Stine was one of the judges in the department of electricity at the World's Fair, and has contributed many articles on electrical subjects to the technical and semi-technical press. Mr. Gaylord received his technical education in the electrical engineering department of the University of Michigan, and was later appointed engineer in charge of subways on the staff of Electrical Engineer Pierce at the World's Fair.

At present there are 32 students in the electrical engineering department, all, of course, doing first year work. When the department is in complete running order there will be three courses open—general elementary, general and advanced technical, and electrical engineering. Entrance examinations are held in June and September. A scholarship certificate of the value of the tuition for one year is awarded to the student who passes the best preparatory examination in such studies as most thoroughly fit for work in the electrical department. A similar certificate of the value of the tuition for two terms is given in recognition of the examination marked second, and a certificate of the value of one term's tuition is given for the examination marked third. While general and elementary instruction is supplied the main object of this department of the institution is to train students for the work of the electrical engineer in one of the several fields.

The statement in reference to the completness of the technical equipment applies with particular force to the electrical department. It would be an almost hopeless task to attempt an enumeration of the apparatus ready for use in this department. Much of it has hardly been unpacked, and has not been placed in position in the laboratory. In the present general article a brief outline of the possibilities in view, with the statement that hardly any instrument or machine that the student may require is lacking, must suffice.

The laboratory and lecture rooms of the electrical de-

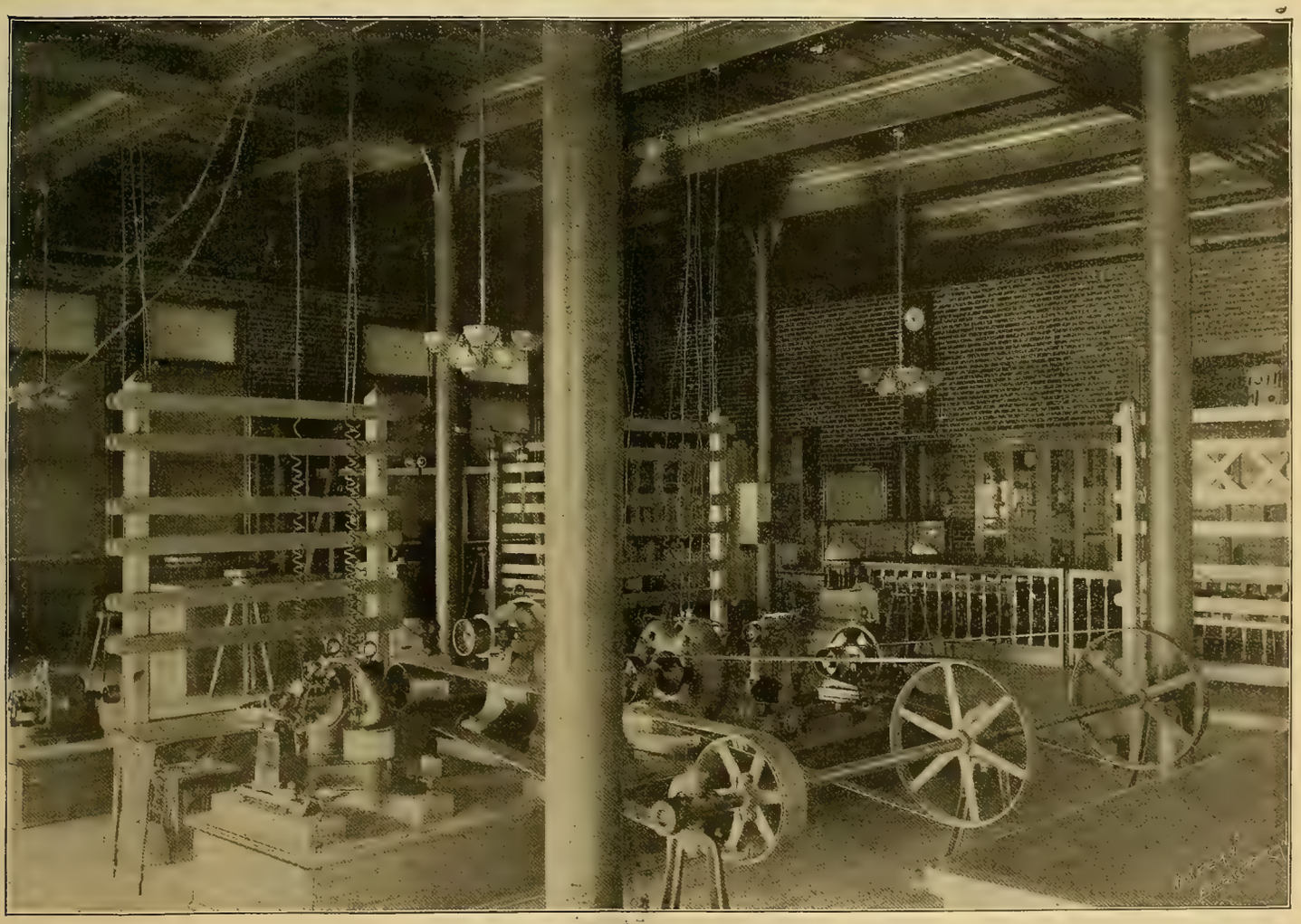

FIG. 1. THE ARMOUR INSTITUTE.—VIEW IN THE ELECTRICAL LABORATORY.

partment are located on the second floor of the building. Views of the former are shown in Figs. 1 and 2. The typical dynamos and motors that are used for study and measurement are shown prominently in Fig. 1. The machine on the left of the line is a Crocker-Wheeler 110 volt five horse power motor obtaining current from the basement plant, and driving the line shaft to which the other dynamos are belted. Then comes a Westinghouse 500 volt direct current dynamo, a C. & C. 110 volt direct current generator, a Westinghouse direct current machine of 110 volts and a small Wagner alternator wound for 110 volts. In Fig. 2 an ordinary bipolar Edison dynamo and a one horse power Wagner motor for operation on 110 volt direct current circuits are also shown. The switchboard frames for these machines are in position, but have not been fitted up. This room is also supplied with facilities for lamp testing, a bank of 100 incandescent lamps and two low tension arc lamps, shown in Fig. 2, being already in position. The laboratory is completly fitted and well adapted for the use of students. There are three large calculating tables scattered about, while at the sides of the room are several smaller tables for experimental work. Each student has a locker, with a private key, for his books and personal effects. The working instruments are in handsome cases arranged about the walls of the room, which is large and well lighted. These include measuring instruments of nearly every make, galvanometers in dozens of varieties, Wheatstone bridges, all sorts of rheostats, standards of electromotive force, capacity, resistance and self-induction, a Ewing magnetic curve tracer, fine Thomson balances, electrostatic voltmeters and many others. Much of this apparatus is of foreign manufacture, and the collection as a whole is remarkably complete and elaborate. The transformers include nearly every one made, while in the line of batteries, induction coils, influence machines, magnets and telegraphic and telephonic apparatus, nothing is neglected. Attention will also be devoted to electric welding and electrolytic processes.

That corner of the laboratory shown in Fig. 2 is devoted to the construction of special instruments and is equipped with the apparatus necessary to enable the student to make anything in this line. A Wagner one horse power motor furnishes power for a light line of overhead shafting, from which is belted a Pratt & Whitney tool lathe and a Barnes speed lathe, supplied with all necessary tools. A delicate Hartmann & Braun jeweler's lathe, directly connected to a ⅛ horse power motor, is used for the finest work, while a ⅛ horse power Perret motor supplies power to a polishing lathe. The equipment of this department also comprises work benches with vises, etc., and a complete assortment of hand tools, systemmatically arranged. The instruction in the manufacture of instruments is under the direct supervision of Mr. Gaylord.

A glimpse of the electrical lecture room is shown in Fig. 3. It is supplied with all needful facilities for class-room demonstration, including a Paragon projector. Prof. Stine has devoted considerable attention to this aid to instruction, and, by means of an arc lamp and projecting lenses, is enabled to throw enlarged reproductions of the illustrations in the text-books or electrical periodicals on a permanent screen. In Fig. 3 the arc lamp projector is shown at the left of the lecturer's platform. On sunny days the curtain of the window behind it is pulled down, but otherwise the light is of sufficient power so that the room need not be perceptibly darkened.

All the mechanical and electrical power needed in the institution is generated on the premises, and the plant has been designed to be of use in the instruction of students as well as for actual service. Two Stirling water-tube boilers of 200 horse power each, with Hawley down-draft furnaces, Fig. 5, furnish steam, the fuel being Indiana slack. The stack is of brick, 130 feet high. The two feed pumps are of the Smith-Vaile type, and the Webster vacuum system is used for heating the feed water, the exhaust steam being employed for heating the building in winter.

In the adjoining engine and dynamo room, Fig. 6, is a 200 horse power Hamilton-Corliss simple engine driving a line shaft by an endless rawhide rope 750 feet long. The tightening pulley, plainly shown in the picture, is above the driven pulley. From the shafting, and controlled by friction clutches, are belted two dynamos, while another line of belting leads to a countershaft on the roof, from which power is supplied to the machine shop on the first floor of the main building. The dynamo on the right is a C. & C. 125 volt direct current machine operated at 750 revolutions. It is compound wound and rated at 800 lights, and has thus far carried the load of the building. The second dynamo is an eight-pole Westinghouse alternator wound for 1,000 volts and of 600 lights capacity. This machine has not yet been operated under load, but it is needed, and will soon be thrown on the house circuits, with transformers on the bus bars of the switchboard, and excited by direct current from the C. & C. machine. The switchboard is of white marble, of three panels, and equipped with Weston instruments. The wiring of the building is well done, but presents no unusual features, save in the cut-out boxes, which are each provided with an incandescent lamp arranged to be automatically cut into circuit by the opening of the door. As cut-out boxes are usually in out-of-the-way corners, the light is a great convenience. About 1,500 16 candle power lamps are connected, and a 12 horse power Perret motor is used to furnish power in the pattern shop.

Included in the plant is a storage battery equipment of 60 cells made by the American Battery company and illustrated in Fig. 7. These cells are placed on shelves in a small room at some distance from the dynamo room, but are arranged to be charged and discharged—the former in multiple and the latter in series—by a switchboard connection. They supply current when the plant is shut down during the day and for the janitors' work at night.

The Coin-in-the-Slot Telephone in Chicago.

The Chicago Telephone company has just placed in several of its public pay stations instruments provided with a slot arrangement which may prove of considerable value to the company, by putting a stop, in a great measure, to the dead-heading at public stations which has been the source of much annoyance to the telephones in general. The idea is not a new one, but it is regarded with displeasure by those who have been accustomed to use telephones without paying for the service. The battery box is much larger than is ordinarily the case. On the top are five slots, respectively large enough to admit a silver dollar, half, quarter, dime and nickel. Each slot has a shute running directly to a bell inside the box. From the top of this box there is a transmitter to carry the sound of the five bells to the transmitter through which the user of the telephone talks. The bells differ in tone, and with a little practice the operator at the exchange can readily distinguish the sound of each. Each instrument is equipped with a metallic circuit and long distance transmitter, so that calls for any station that the telephone reaches can be made. These instruments have been in operation in New York and Boston for some time, and are said to have filled their requirements made upon them with a good degree of satisfaetion.

National Electric Light Association.

C. O. Baker, Jr., master of transportation of the National Electric Light association, announces that the Trunk Line association has granted the rate of a fare and a third, on the certificate plan to Washington and return during the period of the convention, February 27th, 28th and March 1st. The other passenger associations have the matter under advisement, and will, it is thought, in all probability, make their decision soon.

The Electrical Transmission of Power from Niagara Falls.

By George Forbes.

Discussion.

Part II.

S. Evershed said one speaker had referred to the effect when large solid conductors were used; but Prof. Forbes did not say he was going to use large solid conductors, and he (Mr. Evershed) did not doubt that he would not do so. He showed in his diagram of the subway something which might be taken to be laminated strip conductors, so that the skin effect elaborately discussed by Lord Kelvin would not have any prejudicial effect. But there was one effect which would come in, and it was of vastly more importance, and that was the induction between the conductors, whether solid or laminated. It was easy to work out what the back electromotive force of induction would be for any pair of conductors run at any given distance apart, and he had worked out a few cases, taking the conductors to be 6 inches apart, or 12 inches, or 3 feet. He also took the density as 333 amperes per square inch, which he understood the author proposed to use. He found that there was one great argument for using as low a frequency as possible, namely, the enormous inductive drop in the lines if run at the 100 periods of Mr. Mordey. If they had mains of 3 square inches in section, as Prof. Forbes would have, and placed those mains 6 inches apart, if they ran at 100 periods they would have an inductive electromotive force of 880 volts per mile. Running at 25 periods this was reduced to 192 volts, while the resistance drop was 27 volts. On that ground alone Prof. Forbes appeared to him to have an unanswerable argument in favor of low frequency in that particular case. The only other point he desired to refer to was the question of coupling in parallel. He wanted, if possible, to get Prof. Forbes to tell them distinctly what were the uses of an artificial load in coupling machines in parallel.

FIG. 2. THE ARMOUR INSTITUTE.—VIEW IN THE ELECTRICAL LABORATORY.

Mr. Crompton said there had been an important omission in the discussion. The question which was of real interest to them was, What would be the cost of power to the users in Buffalo or in the more distant towns? How would it compete with the cost of power produced in those towns? That was the point which would interest him most. He should think many engineers like himself had had such schemes on a smaller scale brought before them, and in the large proportion of cases they were reluctantly obliged to abandon them because the interest on the cost of the plant was so great as to overwhelm the advantages of using water power. He had been forestalled in many of the remarks he would have made by Mr. Ferranti. The barefaced attempt to pick the brains of the world and then to utilize the information gained for the benefit of the American manufacturers was a thing to be admired. He was sorry to say that similar attempts were often made in this country; he spoke feelingly. There were many who had spent their blood and treasure in the perfecting of the mechanical details and the other details of electrical machinery, and who could not get any reward for their labors simply because no system of patent laws could cover every little detail of design. The regular modern habit was for the last comer to pick the brains of the world, so they must not blame the Americans, who were only doing on a large scale what had been done so often before on a small one With regard to the culvert he would not like to be in that culvert when 20,000 volts was going on. If an arc started at one end of that culvert it would go right up to the other end, the whole eighteen miles, in a very short time. Prof. Forbes was going to use porcelain insulators, and he would ask him if he had made experiments to know what the insulating power of porcelain was. What

was good enough for electric telegraphs was not good enough for underground work, and failures had been made by those, who, without sufficient trial, had adopted the material used for aerial insulators for underground work. They had made great improvements, and had now got a material that carried 200 volts satisfactory; whether they would ever get a material which would carry 20,000 volts was beyond him at present. Oil insulators were supposed to be a great remedy, but he thought there were many there who would agree with him after a long trial that they were entirely useless. He did not think continuous currents had been condemned on sufficient evidence. It was useless for people to get up in that room and say there were no difficulties in the matter of "parallelizing" alternators. Grave difficulties did exist, and although Prof. Forbes might minimize them, and probably would, by his low frequency, he would find he had not then got over the great problems that would arise. He did not agree with Mr. Ferranti that 40 periods were good enough to produce good electric lighting. He had seen many of Ganz's stations at 42, and the arc lighting was disgraceful.

MR. WEEKS asked Prof. Forbes whether his circuits were equally divided on either side with the lead on one side and the return on the other. Prof Forbes declined to answer this question.

MR. MAVOR said it would be interesting if Prof. Forbes would describe the method proposed for ventilating and drying the tunnel. This was a matter of the greatest importance, as constant atmospheric conditions in such a subway were most difficult to maintain. It was notable that the most severe criticism of the scheme for carrying high tension currents along bare conductors in a culvert came from the principal exponent of the similar method of conducting low-tension currents. The author had said in his paper that Mr. Tesla has clearly demonstrated the rapid deterioration of solid insulations with currents of high frequency, but many of these effects are also present with currents of low frequency at an equally high voltage.

MAJ.-GEN. WEBBER said they ought all to feel the greatest sympathy with Prof. Forbes in connection with this paper from one point of view. He had brought before them a paper referring to work not yet carried out, and in criticizing the account he had been good enough to favor them with, they should remember that it was inevitable that modifications would have to be made in carrying out that work.

MR. KAPP gave an abstract of a communication from C. E. L. Brown. Mr. Brown advocated a higher frequency than Prof. Forbes, and with regard to running in parallel said he had been unable to detect any difference between low frequencies such as 15 and up to 100. It was astonishing that even at the present day so much was still said of the difficulty of running alternators, single or multiphase, in parallel. He had run machines of very different types in parallel under the most different conditions, and had never found the slightest difficulty; indeed, he had come to the conclusion that the coupling of alternators in parallel was as easy as, if not easier than, that of direct machines. To adopt the two-phase system using four wires seemed to him a good arrangement, and judging from his own experience none but good results could be obtained. It certainly seemed remarkable, considering the number of designs sent in, many of which were extremely good, that Prof. Forbes should have decided upon about the worst arrangement possible for his machine. He could not imagine a more inconvenient arrangement than the magnetic wheel revolving outside the armature, so that it was impossible to get at the machine while in motion, while losing entirely the ventilating effect of the revolving wheel for the cooling down of the armature.

PROF. FORBES said those who had really studied this problem to some extent, who knew what the difficulties were and where the pitfalls were, must have felt that some of the gentlemen who took part in the discussion had not even begun to grasp the character of the problem before them. He himself had felt nothing but sorrow for the position of the Institution in having such speeches made on a matter of so much importance. In the discordant views expressed by the various speakers he saw a reflection of the train of reasoning which had been going on in his mind during the years he had devoted to the subject, and he saw the beginning of the workings of the minds of those who would have arrived at different conclusions if they had had longer to think about the matter. He was astonished at the manner in which the question of low frequency had been received. He did not claim for himself one atom of credit for having, after most careful consideration, arrived at the conclusion that the lower the frequency they got in the design of their dynamo the better would it be for the working; but now, after the remarks that had been made, he began to look upon himself almost as if he were the discoverer of low frequency. Before going on to discuss the different speeches he wished to say a few words on a subject which Mr. Ferranti had brought forward, and which had also been alluded to in the technical press. It had been said that the international commission was a farce, and that those who prepared schemes had been treated unfairly. Mr. Siemens had in a great measure answered this, and he would not delay them by referring to that part of the subject. But it had been said that it was determined to give to the men who furnished the plans which should be adopted the superintendence of the work. He held in his hands a report which he submitted at the time in which he said that alternating current was to be used, that it was to be of two phases, that 2,000 volts was to be used for the local work, that step-up transformers were to be used to carry it to Buffalo, that the motors were to be synchronizing motors, Tesla motors with two phases, and motors with laminated fields and commutators. The international commission had been absolutely loyal to its compact in giving him the superintendence of the work. The only serious mistake which he made in that report was to recommend the adoption of the Mordey alternators. They knew now that they were not of the right frequency, and that in certain other points they would not suit their purpose. If the discussion had been barren in certain parts, they had at least heard from Dr. Fleming of the methods used at Deptford to overcome electrical resonance, and that was an important point. The indorsement which Dr. Fleming had given to his views he considered to be of great value, and showed that he had given some attention to the subject. When he said that the lines should never be suddenly connected to, or disconnected from, the machine, he said something which others speakers probably considered might be regarded as an axiom. But although it might be the practice in this country, it was absolutely the contrary to the practice in America. Accustomed as Mr. Mordey was to deal only with comparatively small electric

FIG. 7. THE ARMOUR INSTITUTE. — STORAGE BATTERY PLANT.

lighting plants he did not realize what their scheme was to be, and especially he did not realize that theirs was to be a power distributing plant, and that the electric lighting that was to be done was utterly insignificant compared with the rest of the work. Mr. Mordey's opinion that he (Prof. Forbes) had thrown down the gauntlet to electric lighting men showed that he did not realize the nature of the problem; his reference to transformers of small horse power as being applicable to their case also showed it; his willingness to condemn the artificial load on the ground of expense also showed it. With regard to parallel working, Mr. Mordey argued, if 100 periods succeeded, why go down to 25? He (Prof. Forbes) had shown twenty reasons for going down below that. It was true 100 periods would allow of the machines working in parallel without getting out of step. But they wanted more than that; they wanted them to run in step without waste current passing from one to the other and without breakdown. He did not consider that 100 periods would succeed so well as Mr. Mordey would lead them to believe. Mr. Mordey knew quite well that while his alternator worked nicely in parallel it did not work perfectly; he knew his machine had broken down at times. They at Niagara could not afford to experience such breakdowns as he had met with in his comparatively small machines. Mr. Mordey's alternator did not work well enough for their purpose. He said before deciding whether to adopt it or not tests must be made with high resistance between the dynamos in parallel. Mr. Mordey put in a group of Sunbeam lamps in series. The lamps went up and down with a periodicity of a few seconds. From the moment of those experiments he (Prof. Forbes) felt that the machines were not suitable for their purpose. Mr. Mordey thought that artificial loads would introduce greater dangers. He had been utterly unable to see what those dangers were. All he claimed for the artificial load was that it was a help to keep the system from breakdown. They could not afford to have breakdowns. He looked to every possible safeguard that could be devised even though the expense were something greater. In this case there was no additional expense, because the artificial load when not being used for that purpose was useful for other purposes. Mr. Mordey's remarks about skin resistance would be accurate if they could subdivide the 36 square inches required for the conductors of the first 15,000 horse power used at 2,000 volts. But they could not get space for the enormous conductors unless they massed them together, and at high frequencies the skin effect would come in. Mr. Mordey's remarks on transformers caused him the most regret, for they showed him how far he was from grasping the problem. He did not appear to realize the work that must be done by consulting engineers. An engineer was very little likely to advise such a scheme until he had every detail worked out to a very large extent. Foreseeing difficulties with manufacturers, he set to work to design transformers of low frequencies for every kind of work for which they wanted them. Designing transformers for special cases and for larger sizes than usual was somewhat laborious work, but the results were quite certain when they knew the quality of iron used. Efficiency was so high as to be of almost no account at all when dealing with the large sizes which they required for their work. With regard to the question of the electromotive force of the dynamos, he really hardly understood Mr. Mordey, who wanted them to use 500 volts. If Mr. Mordey would estimate the section of copper for 50,000 horse power or so, he would see the difficulties to be met with. That copper section would be about 400 square inches. He had no doubt Mr. Mordey had never realized that until that moment. He could quite understand that with Mr. Mordey's type of machine it would not do to go above 2,000 volts. But he was surprised that Mr. Mordey was not able to realize these two facts; first, that with a 5,000 horse power the space taken up by insulation was quite immaterial, and in the second place that if you shirked the difficulty of insulating to 20,000 in the fixed armature of the dynamo you would have to face it when you came to the fixed transformer. Mr. Mordey's remarks on lighting were quite beside the mark. Theirs was not a lighting station. Mr. Kapp had dealt with the relative efficiency of single, alternating, two-phase and three-phase currents, and quoted Prof. Elihu Thomson's views. Prof. Elihu Thomson had submitted to him the whole of his reasons for his statement, and he examined them most carefully, and found that they owed their error to the common American mistake of estimating the size of the conductor by the amount of drop they were going to allow instead of by Lord Kelvin's law of economical section. Mr. Kapp admitted his (Prof. Forbes') proof that the losses in the field of a multiphase motor were increased 42 per cent. in the case of a particular motor when they doubled the frequency, but he claimed that a machine with twice the number of poles running at the same speed gave 2½ times the power. Had it not been Mr. Kapp who said that he would have taken no notice of it. But in both of them they had the same total number of lines of force rotating with the same velocity round and round the armature, generating the same electromotive force in the armature and the same current. There was no difference whatever in the power developed in those two machines, and the 42 per cent. remained as he (Prof. Forbes) had given it. Mr. Kapp

FIG. 3. THE ARMOUR INSTITUTE.—LECTURE ROOM, ELECTRICAL DEPARTMENT.

said they could not find space to put rings on to a direct-current motor to convert it into a synchronizing motor. He (Prof. Forbes) did that last summer with one of the stock machines supplied by the Westinghouse company. Mr. Kapp said he did not know how he would start that motor. The motor would only require to be started once in several months, yet he had started it without recourse to Tesla motors. Mr. Kapp said he had objections to low frequencies with motors, but he did not give his reasons. He heartily thanked Mr. Kapp for the way in which he spoke of his (Prof. Forbes') machine; he was exceedingly glad that a man of such eminence in designing as Mr. Kapp had spoken so well of the machine. He need hardly say that if he dreamt that the Cataract Construction company were acting in any unfair way he should cease to be connected with the work. Mr. Ferranti had been good enough to tell them that he had stolen this machine from C. E. L. Brown. Mr. Brown said it was the worst possible design that could have been devised. He knew it was simply a ridiculous assertion that the design of that machine could be said to be in any sense like that of Mr. Brown; but he was glad to be able so promptly to bring a a quotation from Mr. Brown to show that he did not think so. He believed his (Prof. Forbes) machine was the first which had been designed upon a principle which ought always to rule the design of a large machine of a new type of construction where they had not past experience to go upon, and that was that they should reach the most economical efficiency. In this design he had added material until he reached a point at which $60 worth of material did not save one horse power. He had found, as the result of experience in trying parallel running with different types and a certain number of different frequencies, that lowering the frequency increased the efficiency, and not only the ease, of parallel working. With regard further, to Mr. Ferranti's remarks, he denied *in toto* that any person had the right to say that the design of that machine had a plausable resemblance to the design of any machine that was put before the company. He was seeking to get the best design he possibly could, and in so doing it so happened that he differentiated that machine from any one of those sent in infinitely more than they were differentiated among themselves. Mr. Ferranti said he was wrong in saying that 20,000 volts completely insulated was so very good. He (Mr. Ferranti) thought 10,000 volts with one pole to ground was better. He gave as his reason that with the 20,000 volts, if one conductor was put to the ground, the whole insulation was reduced to 10,000 volts. Yet he admitted that he had one of his own conductors to ground; suppose the other got put to ground by any means, how many volts insulation would that be reduced to? It might be that by using concentric cables they avoided the chances very much of putting the other one to ground, but there were connections and numbers of other means by which it could be put to ground far more likely when hidden underground than in the subway. They owed some gratitude also to Mr. Evershed for working out the back electromotive force due to the inductive action of the conductors, and for showing them how valuable low frequency was for that reason. Mr. Crompton complained that he had not given the cost. Mr. Crompton might be perfectly sure that when they knew the actual cost down to a penny he would not give him the cost then either. There were some things he could not tell them, but he did not think the Institution had any right to complain of his not having been candid enough. The result of the discussion upon his mind had been, first, astonishment to find that he was a discoverer instead of a plain, straightforward plodder; and in the next place he was impressed by the vast differences of opinion expressed by different members of the Institution. He felt a good deal fortified in all the conclusions he had arrived at by the general result of the criticisms, however opposed to his views they might have appeared to be. It might be premature for him to say so, but he felt now that all those who had entered into the discussion would, with further study of the subject, ultimately arrive at his position. Meanwhile he thanked them heartily for the expression of their opinions; he appreciated their motives, and he appreciated the value of what had been said by some of them. At the same time he could assure them that he had not lost one particle of confidence in the perfect success of the work that was being carried out; in fact, his own opinions had been strongly confirmed by the general result of the discussion.

The president said although the hour was very late he was certain they would not wish to close that meeting and the session without conveying to Prof. Forbes their deep thanks to him for having brought that subject before them, and for having elicited such an important discussion. They had evidence before them that night of Prof. Forbes' enthusiasm and his nervousness, or rather his suppressed anger every now and then had kept him from that fluent defense of his position of which they were more familiar. He was quite certain that if anyone of them had worked for years on a tremendous undertaking like that of Niagara, and had been as severely handled as Prof. Forbes had been, they would not have remained as cool as he had.

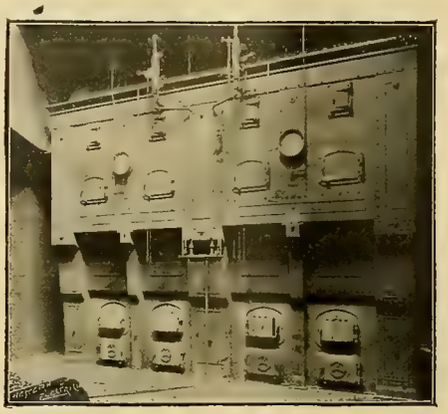

FIG. 5. THE ARMOUR INSTITUTE.—BOILER PLANT.

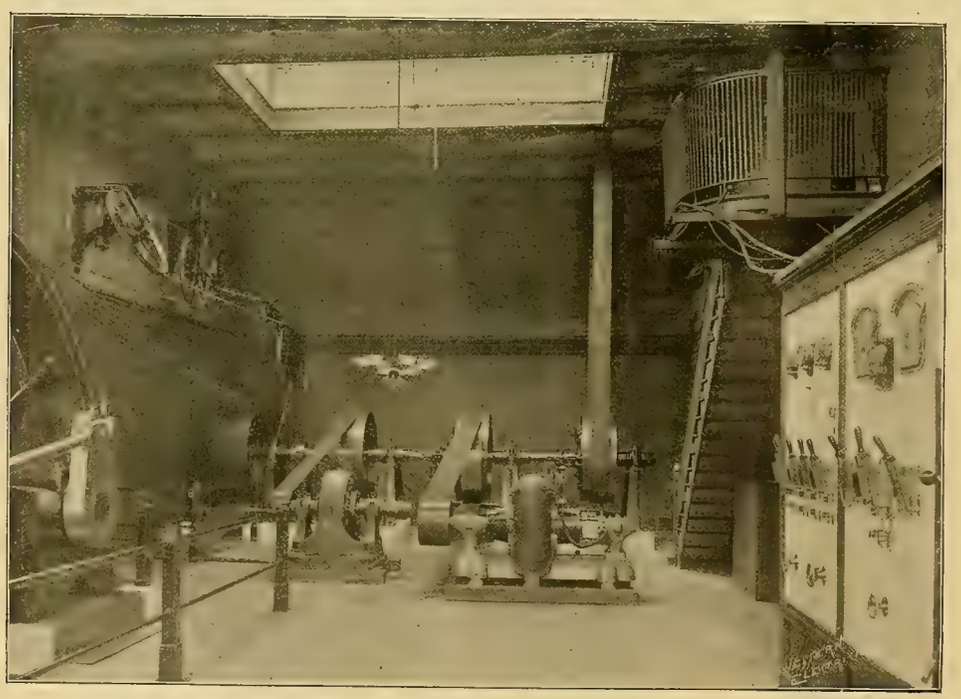

FIG. 6. THE ARMOUR INSTITUTE.—ENGINE AND DYNAMO ROOM.

Electricity Building Not Damaged.

During the fire at Jackson Park last week the electricity building was threatened by flying sparks, but men were stationed on the roof, and although a blaze was started at one time, it was quickly extinguished. After the fire there was a report that a number of boys had been surprised in an attempt to set the building on fire, but the rumor was not confirmed. The casino, peristyle and music hall were totally consumed, but as these structures were empty and must necessarily be destroyed in any event, the only actual damage was in the manufactures building, where a number of cases of foreign exhibits were injured by water. Probably the total loss was less than $20,000. Nearly all the exhibits have been removed from electricity building.

An ordinance granting an electric lighting franchise is under consideration at Baker City, Ore.

The Practicability of Electric Conduit Railways.[1]

By Albert Stetson.

Part I.

Two years ago, if an electrical engineer had been asked as to the practicability of an electric conduit railway, he would probably have shrugged his shoulders and expressed great scepticism as to ultimate success. The writer hopes to be able to show that some real progress has been made since then, and that the way out of the difficulty is in sight.

Electric traction for street railways has come to stay, and we must choose between the trolley, secondary battery and a conduit construction (either slotted or closed). The trolley has been and still is the most important factor in electric traction. It has done and still is doing excellent work in educating the public into the beauties of rapid transit in cities. There is much talk in our sensational daily press about the "deadly trolley," but much of it is ridiculous, and most of it undeserved. Surely no member of this Institute has joined in this outcry, and it would be a move in the right direction if some of our daily papers would have attached to their staffs men who are capable of judging of technical subjects, so that they might be able to impart correct ideas as to the march of human ingenuity and progress. Our daily newspapers have specialists to report society scandals, dog-fights, pugilism and horse-racing. But is it not strange that none of them employs trained technical experts? The progress of the arts and sciences is certainly as interesting to the average man and woman as is what ladies do and say in a Turkish bath! It is, perhaps, useless to undertake to reform the press in this respect, but, until we can, we must expect from time to time to hear of the "deadly trolley." There is a field, and a wide one, for the trolley, and the men who have devoted their talents and their money to advancing electric traction by the trolley deserve well of the race. Many men have worked in this field, but I believe that Frank Sprague, with his twelve miles of road in Richmond, working successfully, sent electric railways forward twenty years. All honor then to the trolley men! They have and will hold for a long time the field in smaller cities and towns, and for inter-town communication. Railroad men, as a rule, are very conservative, and until a few months ago there was nothing in sight that gave promise of our being able to do away with the trolley in cities. Certainly they could not be expected to wait until something practicable appeared, nor could they afford to stop their ears as soon as they heard of fairly successful experiments with a conduit railroad. Large vested interests cannot be overthrown nor changed in a moment, and it will be interesting to see what position trolley men will take when the conduit has demonstrated its utility and practicability. I expect to find them more than ready to adopt it wherever the traffic will warrant them in so doing.

We have admitted the claims of the trolley people, and given them due credit. But there are also rights of the public that must be respected. The streets of our cities belong to the public, and not to corporations. So long as nothing better was in sight, it was to the advantage of the public to have rapid transit, even though the trolley were the medium. But the structure is unsightly, and the poles and wires are a constant menace to the public. A trolley current will not, probably, kill a man who has no organic disease, but it will kill an animal, it will terribly burn any one who comes in contact with it, and would probably cause the death of a man troubled with heart disease. The feed wires are a constant source of danger. A trolley wire may get crossed with an electric light wire carrying an arc current, and it then becomes a dangerous thing. If the streets are at all wide, very large poles, taking up too much sidewalk space are used, and these invade public rights. We have a right to beautiful streets, and no corporation, for the sake of private gain, has a right to disfigure them. We have a right to safe streets, and no corporation has a right to contribute anything toward rendering them less safe. In our cities and large towns trolley as well as other current conveying wires must go underground so soon as any economical and practicable method is demonstrated.

Secondary batteries have been used in nearly every large city of the civilized world to supply the demands for electric traction, but have been given up as too costly. I know there are still people who are willing to spend their money on this *ignis fatuus*, but the number is growing beautifully less year by year. The writer has spent much time in investigating the subject here and abroad, has examined everything in this line that Europe has offered, and he asserts, without fear of successful contradiction, that not one instance can be found in the world where a traction secondary battery has paid an honest dividend. The cars (if supplied with sufficient power) are too heavy for ordinary track construction, the heaviest ballasted steam track being scarcely good enough to insure them a commercial life. The conditions essential to the life of a secondary battery are large, thick and heavy plates. Such a battery can probably be commercially employed in lighting stations, but those are diametrically opposed to the conditions for a traction battery. In traction the battery must be small (on account of the limited space at our disposal) and it must be light, for every 150 pounds of lead carried means the cost of transporting a passenger. To run successfully, we must be able to ascend such grades as exist in railway work, and when sufficient battery power for this is carried, the car becomes unwieldy. A sudden call for power on a small battery may tear it all to pieces, and the "self-contained" car then becomes anything but an "ideal" motive power. When, in 1881, Sir Wm. Thomson carried across the channel, Faure's little box containing 1,200,000 foot-pounds of electrical energy, great hopes were excited, and those million foot-pounds of energy was soon changed into millions of shares, and that changing process has been

1. Read before the American Institute of Electrical Engineers, New York, December 20, 1893.

going on ever since. The average investor did not, of course, know that those large figures represented about the energy of 1½ ounces of coal, and that, if Sir William had brought his pockets full of good cannel coal, the supply of energy in Old England would have been much increased, but investors did believe that there was the "ideal" system for electric traction. The best electrical, chemical, mechanical and engineering skill was employed, improvements were made on the original cell, millions upon millions of dollars were spent, and the results have been financially disastrous. Remember, please, that, to any but the electrical crank, the treasurer's books are the court of last appeal. The experience has been costly, and the shores of Old England are strewn with the wreckage of secondary battery ventures, and the bones of many a victim lie bleaching in the sun! But has nothing been done since then that gives promise of better things? Judged by my standard (the dividends paid), I answer, "No;" and to one who understands the principles involved in a successful traction battery there seems to be nothing in sight to bid us hope for a successful solution of the difficulty from this direction. Should future metallurgists make us acquainted with some new metals, or should a cheap supply of palladium become available, the problem may be changed. But the writer believes the experiments of the E. P. S. company in England and those of the Julien company in this country exhausted the possibilities under commercial conditions, and that we have seen no better battery than theirs. It is often said that the patent complications stopped the secondary battery experiments in this country (they did not in Europe), but I am unable to understand how. The Brush company has the patent rights, and the Julien company, or its successors, the exclusive license, and I have not heard of any extraordinary exertions on the part of the Brush company to reduce their surplus by secondary battery experiments—and I do know that the cars used in the Julien company's Fourth avenue trials are for sale at "genuine bargain" prices. I admit that I may be mistaken, but universal experience is a pretty safe guide, and any one trying to work out a system of accumulator traction has my sympathy, and my prayers that he may early see the error of his way and return to the fold before the last fatted calf has been killed and eaten!

FIG. 4 THE ARMOUR INSTITUTE.—EXTERIOR VIEW.

In a paper read before the American Street Railway association at Pittsburg, on October 21, 1891, George W. Mansfield said:

"Our rival is the cable. It certainly does look as if for the enormous sums they expend in making their system feasible, we ought, for an equal sum, to make ours perfect. Mechanically it is an assured success, but electrically it has not so proved."

In large cities the cable is a real rival of electric traction, and in many places has proved commercially successful. But there are some things that may give the electrician hope. The cable roads of St. Louis have to a very great extent given up their cable and are using the trolley, while those of Kansas City and Denver are said to be in a bad condition financially. City railroads in the future will, no doubt, be electric, and it is questionable whether any more cable roads will be built. The cost of the powerful machinery required, the wear and tear upon the cable and the grip, the large amount of real estate required for their buildings constitute serious "first charges" upon the earnings of cable companies, and confine their operations to very large cities, where traffic is enormous. Electric traction demands only a portion of the expense necessary for a cable road, and capital is seeking this method for investment, while "fighting shy" of cable roads. When a car is on the track, ready to be moved, it is a question of veracity between the electrician and the cable man as to which motive power can move it more economically. Perhaps the advantage lies a little in favor of the cable man, but when interest on capital invested in buildings, real estate, machinery and the natural deterioration are taken into account, the electrician appears to have much the better of the argument. It is, of course, true that the cable traction has greatly increased the revenue of the Broadway line, but so would electricity have done. It is a well known fact that the better the facilities offered for travel, the more people will avail themselves of them, to the increased profit of the company supplying the need. There is nothing in the cable success here in New York to discourage the electrician, and I hope to see in a few years a conduit system in operation on Broadway and Third avenue.

There is one other class that may be mentioned in passing, where mechanical motors are employed on the separate cars. Many different motors have been proposed, such as carbonic acid gas, ammonia, gas engines, hydraulic motors and compressed air. None of these have, to my knowledge, demonstrated their commercial utility, although I think the future outlook in this direction is promising. Some years ago, in company with Mr. Stauffer of this city, I rode over the road from Vincennes to Paris on a line operated by the McClosky compressed air system. Its operation was all that could be desired from a spectator's standpoint, but I mistrust it had the same trouble as many others—good enough to spend money on for experiments, but unprofitable from a financial point of view.

We now come to a consideration of conduit roads, their excellencies and their defects.

For years electricians have worked to develop a practicable conduit system of electric railway, and many attempts have come near to success. The most extensive and, until recently, the most successful was the Bentley-Knight system. An immense amount of money was spent, the best talent was employed, and extensive lines were built at Cleveland and Allegheny City. Experiments were made in New York and Boston, and with the withdrawal from the field of the Bentley-Knight system disappeared the last hope of our being able to place bare wires in a slotted conduit exposed to the severe conditions of our American climate. There is not a city in America to-day where a bare conductor laid in a conduit can earn a dividend on the capital invested. No matter what the system may be, no matter how carefully the insulators may be protected, unless the conduit is made air-tight and water-tight (which, of course, no slotted conduit can be), mud and dirt will get into the conduit and settle on the conductors. Leakage takes place from a conductor in proportion to the length exposed, and glass, porcelain, ebonite or any other of the so-called insulators, when covered with dirt, conduct the current as well as a similar layer of dirt elsewhere would do. Over the path in this direction Nature seems to have posted the warning "No thoroughfare."

F. L. Pope, in an article quoted by Carl Hering,[1] says, in speaking of conduit experiments: "Hundreds of patents has been taken out and more than a million dollars have been disbursed in paying for tuition in the costly school of experience. More than once, and in more than one direction, success has at times seemed almost certain; yet the truth compels me to say that, from the hard, practical standpoint of dollars and cents, by which every invention must first or last be tried, the net outcome of all this vast expenditure of labor, time and money has, up to the present moment, been almost insignificant. The award which awaits the fortunate person who succeeds in completely solving this problem may well be regarded as a potentiality of wealth beyond the dreams of avarice. The problem of the underground circuit does not at first sight appear to be a very difficult one. It renders necessary, in the first place, a construction which will effectually resist the action of forces tending to disturb the condition of the wires, and with the heavy traffic on the streets this involves a very strong structure. It is absolutely necessary that the conductors shall remain insulated from each other and from the ground under all conditions of weather. The exigencies of heavy rains and snows necessitate a construction which shall permit of a thorough insulation of the conductors and a drainage of the entire system. There are other minor points which require to be taken into consideration. Without going into details, it is sufficient to say that the conduit system has been tried on an extensive scale in Denver, Cleveland and Boston, and to a lesser extent in several other places, but in every case the continual interference consequent upon its use has exhausted the patience of the traveling public and compelled its abandonment."

1. "Recent Progress in Electric Railways," pp. 168–170.

Mr. Mansfield, in the paper already quoted (also Hering, p. 170), says: "In spite, however, of all this refinement and study, practically nothing has been accomplished; and I have no hesitation in saying that the continuous live conductor in an open slotted conduit is to day a failure, and that it cannot be made a success throughout our cities of to-day, its fatal weakness being our inability to prevent the conduit from becoming filled with water, mud, etc. The time may come when our sewerage systems will be perfect enough to enable us to overcome this fatal weakness. To-day, however, they are not, and even an optimistic view puts this time a long way distant."

F. H. Monks, of Boston, says: "The conduit system has been thoroughly tested, and has been shown to possess no commercial value for the propulsion of street cars to date."

The standard work, "The Electric Railway in Theory and Practice," by Oscar T. Crosby and Louis Bell, says (p. 255): "The fundamental difficulty with all slotted-conduit electric roads is the enormous difficulty of proper insulation. This arises from the very nature of the case, for the conductors are placed in a tube of limited diameter in free communication with the open air through the slot. Water, dirt and mud inevitably find their way in, and sooner or later the result has been either a positive short-circuit at a single point, or general leakage along the line in sufficient quantity to paralyze its operation."

The Northwestern Elevated Railroad Company.

The ordinance of the Northwestern Elevated Railroad company, twice amended by the Chicago council and twice vetoed by the mayor, was signed last week by Mr. Hopkins. No changes were made by the mayor, and he asserted that he had no reason to believe that the road would not be constructed. Alderman Tripp, who has fostered the measure, assured Mayor Hopkins that the ordinance would be accepted by the railroad men, and said that within two weeks the $100,000 bond provided for in the ordinance would be placed in the hands of the city officials

Since the final passage of the ordinance some of the Chicago papers have published a plan, which it is claimed has been in the minds of the promotors of the North Side elevated road for a considerable length of time. It includes the extension of the proposed road north to Milwaukee, running through Evanston, Waukegan and several other towns between here and Milwaukee, and several branch lines. Extended purchases of real estate in this territory seem to be about the only authority for the tale, but the subject has been freely discussed and at least some minor steps taken in the matter.

Wire Thieves.

For some time the Chicago Telephone company has been troubled by the loss of wire. Frequently, it is claimed, as much as six or seven miles has been removed from one place. The operations of the thieves were not confined to overhead wires, but service wires in conduits were also stolen, and it is said that fully 40 miles of telephone wire have been lost by the company in the last three months. A month or so after the telephone company began to suffer, the South Side electric railways also began to lose wire. Once or twice every week a raid would be made on one of the electric lines, and an aggravating delay would follow until the break could be repaired. The loss of the companies soon ran into hundreds of dollars on traffic alone. Sunday afternoon two young men were seen winding up half a mile of wire on Lake street. They were arrested, and it is thought that the leaders of a gang engaged in this work have been secured. Other arrests have been made, and it is to be hoped that the telephone and railway companies will now be allowed to give uninterrupted service.

Northwestern Electrical Association.

Every effort has been made to provide for the entertainment and comfort of the visitors at the convention of the Northwestern Electrical association held in Milwaukee, Wis., commencing Wednesday, January 17th, at 2 P. M. The original intention was to continue the meeting for two days, but it has been decided to extend it one day longer. On the evening of the second day a banquet will be given at the Hotel Pfister. Visits will be paid to places of interest in Milwaukee and the vicinity. Among the proposed places to be visited are the Milwaukee Street Railway company's new shops, the power house of the E. P. Allis company, the Pabst Brewing company, the Edison power station, the Siemen & Halske power station and the Badger Illuminating station.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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WE have tried advertising in several electrical papers, and after discontinuing our advertisement in your journal [*Electrical World*] we advertised for a considerable period in the WESTERN ELECTRICIAN, which we found a valuable paper for reaching the West, our card in that paper bringing us many communications, a number of which resulted in sales of our alternating apparatus, including a plant for the University of Wisconsin.—*Extract from a letter of F. A. La Roche, president of the La Roche Electric Works, Philadelphia, to W. J. Johnston, publisher of the Electrical World.*

SINCE the publication of the WESTERN ELECTRICIAN'S editorial of two weeks ago nearly all of the Chicago daily papers have taken up the matter of the expiration of the fundamental telephone parent on the 30th of this month. A good deal is being done in the direction of informing the public in regard to the telephone situation. This is the right course to pursue, as the demands of the telephone monopoly on the telephone users have been so unreasonable that it is the duty of the press to make it plain to the public that the days of extortion are now over. And in the performance of this good work care should be taken to have it fully understood that there is only one patent standing in the way of the free use of the telephone and all its needful accessories and combinations, and that that patent expires January 30th. A portion of the daily press has made the mistake of assuming, practically, that only the private line field is to be thrown open, the exchange system being so well fortified by subsidiary and combination patents that the larger cities and towns offer very little inducement to capital to invest in competing exchange systems. This is a wrong conclusion, as these minor patents are narrow in scope, and without in any way infringing upon them inventors and manufacturers will find little difficulty in supplying the competing exchanges with a full line of apparatus necessary to make them thoroughly efficient and successful. Now that the situation is being made clear there is little doubt that electricians, manufacturers and inventors will promptly avail themselves of the opportunity, and we venture the prediction that the public will be most agreeably surprised by the excellence of the apparatus and service offered it and at the reasonableness of prices and charges, all of which can well be afforded with plenty of margin left for returns to capital.

Already every indication points to great activity and vigor in the coming telephone war. In Chicago especially the prospects for healthy competition are bright. Beside the old company, two others are in the field for local exchange business, one having already secured an ordinance, while the application of the other is pending in the council. The latter covers the entire city, providing for underground wires in the central district. The annual charge for the service is not to exceed $75 for the first year, $70 for the second year and $65 thereafter, and the company agrees to pay semi-annually into the city treasury five per cent. of its gross receipts. The present rental rate of the old company is $125 per year, nearly double the minimum rate proposed. We hope that the new companies have a clear understanding of the task that lies before them, with resources sufficient to enable them to make an honest effort to supply an adequate telephone service in Chicago independent of the Bell interests. If this effort is made in good faith, the competing companies deserve and will no doubt receive the support of the business men of Chicago, who will gladly have their old instruments removed if convinced that the new service will enable them to reach their business associates at a lower price. The complication introduced by rival exchanges forms the most perplexing feature of the situation, but undoubtedly a means will be found to lessen the threatened inconvenience, perhaps by some sort of an understanding between all the anti-Bell companies.

WE congratulate the daily papers of Chicago upon the advancement they have made, which is shown by the publication of the statement that the fire at Jackson Park which destroyed the casino, peristyle and music hall was not caused by electric wires. Of course it would be very hard even for the daily papers to attribute the fire to electricity, inasmuch as all the wires had been removed from the building in which the fire started, but it is a hopeful sign that the daily papers perceived the fact and that they published a statement to that effect. It is possible that some day they may investigate the causes of mysterious fires in buildings containing wires and not take it for granted that electricity is the cause of these conflagrations.

THE concluding installment of the discussion of Prof. Forbes' paper on the "Electrical Transmission of Power from Niagara Falls," which was read before the Institution of Electrical Engineers at London, is presented elsewhere in this issue. It will be noticed that the criticisms of those who did not agree with Prof. Forbes applied not only to the plans which were finally adopted, but to the method pursued by the Cataract Construction company in securing specifications from designers and engineers. That Prof. Forbes appreciated the significance of the criticisms, and undoubtedly construed them as a reflection upon his personal integrity as well as an attack upon the company's policy, is shown by a statement from him published in an English contemporary. In this communication he denies that he has availed himself of the ideas of others who submitted plans and designs for machinery. It had been charged that Prof. Forbes had appropriated special features designed by C. E. L. Brown in the construction of the 5,000 horse power dynamos adopted by the company. Concerning these charges Prof. Forbes says: "I am quite sure that Mr. Brown would corroborate the statement that the general features of the designs are totally distinct. But my critics particularize the charge by saying that I have taken from Mr. Brown's design the idea of winding the armature with copper strip, insulated with mica. Is it claimed for Mr. Brown that he is the originator of such a proposal? Mica insulation is largely used in the States; and further than this, I have in my office the drawings of the first 5,000 horse power alternator which I designed long before Mr. Brown got out his design, in which the winding above referred to was adopted. In my latest design, however, it happens that the armature is wound with cotton-covered copper wire, No. 0 B. & S. gauge. It is true that the fields are wound with copper strip, but the insulation is tracing cloth." The charges and insinuations of Messrs. Ferranti and Crompton against the policy of the company are flatly denied by Prof. Forbes, who says that the company has already paid $90,000 for engineering advice to English, Swiss and French engineers, something that has never before been done. Furthermore, it is asserted, on behalf of the company, that it took no advantage of those who submitted proposals. On the contrary Prof. Forbes says:

The Niagara enterprise is probably the first American enterprise that ever came to Europe, saying, "We have already subscribed our capital in America, and we are ready to exchange such portion of our cash as may be necessary to secure the brains to properly conduct our enterprise." I confess I am ashamed of my countrymen, and cannot imagine what is the animus which has led to so willful a misconstruction of such liberality, foresight and straightforward dealing.

It is to be regretted that such a controversy should heave been possible, and it is to be hoped that whatever misunderstanding may exist will be speedily cleared up.

DISCUSSION of rapid transit plans for Chicago is now occupying considerable attention, and it is noticeable that there is a marked tendency toward the general adoption of electricity as a motive power. Samuel W. Allerton, one of Chicago's most successful business men and a large holder of street railway securities, has come out as an earnest advocate of the electric motor in place of the steam engine on elevated roads. Mr. Allerton points out that a vast saving could be effected in the operating expenses of the Alley "L" road if motors were employed instead of steam engines. He recognizes the fact that in order to secure permanent financial success the road must extend its line further north, penetrating the heart of the business district, and he submits that this can only be done by the employment of electric locomotives, as the business men would not consent to the use of steam engines in the retail district. The arguments which Mr. Allerton advances have long been recognized by electrical engineers, and it is certainly a most encouraging sign to see that holders of securities of this kind are becoming impressed with their force. Mr. Allerton does not approve the policy of the directors of the Alley "L" road. He says: "I told them from the first that they should use electricity, and they will come to it yet, but they are too slow. They are burning up their earnings in hard coal and paying it out to engineers, firemen and other employes absolutely necessary to the system of steam motors. But they would not believe me. They went ahead and loaded the structure with steam locomotives. They burn $6 worth of coal every day, or more, in every engine, and the engineer and fireman must be paid $3 a day each. Now that is $12 per day for every locomotive, to say nothing of the cost of repairs and care. With electric motive power they could move faster and handle more cars, with a saving of from $8 to $10 a day on every motor. With electric motors the Alley Elevated could save $50,000 a year in the operating department alone and could run faster and haul more people with a great deal less noise and nuisance."

Generally speaking, Mr. Allerton expressed the belief that from an investor's view point there was no question of the superiority of electricity over other forms of energy for railway propulsion. His extensive street railway interests, not only in Chicago but elsewhere, give additional weight to his arguments. Concluding, Mr. Allerton said: "It should be kept in mind that rapid transit makes more money for stockholders than slow transit. Cable cars are better properties than horse cars, and electric cars are better paying property than cable cars. I changed the City Railway horse cars to cable cars, and I have some electric lines in other cities that have proved to me by earnings that they are more satisfactory all around, and better money makers than cable cars; and Chicago wants to be at the head of the van of progression, and there is no doubt in the mind of any intelligent man who has investigated that electricity is the coming motive power for surface and elevated railways. It will not be long until the surface steam railways will be using electricity as a motive power. The Pennsylvania railroad will soon have a competitor in the field between Philadelphia and Harrisburg, in the form of an electric railroad. There was an electric elevated railroad on the World's Fair grounds. Why not one outside of the grounds?"

Chicago will have an electric elevated road soon on the North Side, it is believed, and it is to be hoped that the roads now being operated by steam engines, together with the Metropolitan, will introdnce electric motors.

The Theory and Design of the Closed-coil Constant Current Dynamo.[1]

By Henry S. Carhart.

Constant current dynamos for arc lighting have been in practical use for the last fifteen years. Most of the public lighting by arc light service has been done with dynamos of the open-coil type. They secured the field at an early day in the development of this branch of electrical industry through the inventive genius of Charles F. Brush and the splendid ability of his business associates. This success was repeated a little later by the equally brilliant achievements of Profs. Thomson and Houston and the phenomenal management of the company formed to exploit their patents. Aside from any question of inferiority, it is therefore easy to see why the closed-coil dynamo for constant currents has remained so long in the background. It has not received the attention to which it is justly entitled and has not been investigated with the thoroughness and skill which it merits. It is not my purpose to draw any comparisons whatever between open and closed-coil armatures. The former is entitled to that consideration which long continued and satisfactory service in public and private illumination has earned for it. But the latter is making its way into public favor, and it has certain peculiarities which make it an interesting subject for study. If I were to draw attention in this paper to comparisons between dynamos of different types, it would be between those for constant potential and those designed for constant current, both with closed-coil armatures. For in almost every particular the latter is diametrically opposite to the former. The one is designed to give a constant potential; the other a constant current. One is shunt or compound wound; the other series wound. In the one the resistance of the armature is as low as possible in comparison with the field; in the other the armature resistance is relatively large compared with the field. The one has a sensitive field and is worked below the saturation point; the other should have a staple field, which is worked well up on the saturation part of the curve of magnetization. Ideally the characteristic of the one is a horizantal line; that of the other a vertical line. In the constant potential machine the brushes are set only slightly in advance of the theoretical neutral line on plane; in the constant current dynamo the brushes may be at any point on the commutator according to the load, while the neutral plane remains fixed. When the load decreases with the one the brushes if moved at all are rocked backward for sparkless commutation; when the load decreases with the other the brushes are rocked forward for minimum sparking or even sparkless commutation and constancy of current. When the load increases on the one it governs by an increase of induction from an increasing field; when the load increases on the other it governs by decreasing the counter electromotive force in the coils between the brushes and the neutral plane. In the one armature reaction is purposely reduced to the smallest dimensions; in the other it is purposely made of considerable dimensions. In these comparisons it is assumed that the speed is constant in both cases. If some of these statements are not self-evident, they will be supported, I hope, by subsequent portions of this paper.

The neutral plane independent of the plane of commutation.

By neutral plane is meant a plane passing through the axis of the armature and so situated with reference to the poles of the field magnets that when a coil of the revolving armature is carried across it the electromotive force generated changes direction. This plane intersects the armature in a straight line, but it may broaden out more or less into a surface of small lateral dimensions.

The plane of commutation is a plane passing through the armature axis and the points of contact of the brushes on the commutator. It is the plane joining the poles of the armature considered as an electro-magnet. This latter plane of course shifts with the brushes, since the poles of the armature are the points at which the current enters and leaves the armature, and these are necessarily the points or surfaces of contact of the brushes with the commutator, assuming that the connections from the armature to the commutator run directly out parallel to the shaft. To state the proposition now under discussion in the form of a question, Does the neutral plane shift when the brushes are shifted forward or backward? If we were to make answer from the assumption that the resultant of two impressed magnetizations or magnetomotive forces may be obtained in the same manner as the resultant of two forces by means of the triangle of forces, we should probably conclude that the neutral plane rotates forward with a forward movement of the brushes. But experiment along several different lines shows that this conclusion is in error. If we were to apply to the solution of this problem the principles derived from constant potential machines, we should be forced to the conclusion that, to maintain sparkless commutation at the brushes, the lead of the brushes beyond the neutral plane should be constant, since the current remains constant, and therefore that any attempt to govern for constant current by rocking the brushes must be attended by destructive sparking, unless at the same time the field is greatly modified. But these conclusions are also erroneous. We must therefore first establish the facts and then make a theory to fit them.

The fixed position of the neutral plane I have determined on a ten light machine in two different ways.

First Method—Four turns of No. 16 silk-covered magnet wire were wound around the armature ring as an exploring coil. One end of this coil was soldered to a copper band or ring fastened on the commutator and insulated from it by several thicknesses of mica. The other end was soldered to a piece of brass let into a fiber collar placed around the commutator. One extra brush was fastened to one of the main brush holders and rested on the copper band. The other extra brush rested on the fiber collar and could be attached to any point of a circular scale made concentric with the commutator. A twisted cord ran from these two brushes to a telephone at some distance. When the dynamo was running the movable brush, which rested on the fiber and made contact with the brass strip every revolution, was moved around the circle till a minimum sound was heard in the telephone. The exploring coil was then on the neutral plane at the instant when the brush made contact with the strip. Motion of the brush either way caused the sound to increase in loudness. The position of the exploring coil for minimum sound was found to be about 5 degrees in advance of the normal plane intermediate between the pole pieces; and its position did not change from full load to no load as far as could be detected by this method.

Second Method—To the brush holders was attached an insulating ring slotted on the periphery at every ten degrees on a milling machine. It was made as nearly concentric with the commutator as possible. A third brush holder was placed in the successive slots, and the potential difference between it and one main brush was measured in its several positions. These measurements gave the integrated potential difference between the main brush and successive points on the commutator all the way around the circle and back to the starting point. This was done with no load on nearly short-circuit with a load equivalent to three lamps, and finally with a load equivalent to nine lamps, the current being ten amperes in each case. The results in the first two cases are plotted around a circle in Fig. 1. Positive values, or those in which the potential of the third brush was higher than that of the main positive brush, are set off outside the circle in the upper part of the figure, while negative values are set off outside in the lower section of the diagram. The direction of rotation is clockwise. With no load the highest positive potential was about 78 degrees behind the positive brush. From this point it fell again, and at 128 degrees it was the same as that of the positive brush. For all the coils between 0 degrees and 128 degrees the integrated positive and negative electromotive forces exactly equal each other. The neutral plane falls evidently 78 degrees behind the brush, or the brushes may be said to have a lead of 78 degrees with no increase in sparking. A negative maximum occurred at about 260 degrees, and the potential difference between the positive and negative maxima was 644 volts. The same potential difference was found by direct measurement when two extra brushes were set at these points.

With a load equivalent to three lamps the brushes were rocked back 15° to bring the current to ten amperes. Hence the zero of this curve begins 15° back from the zero of the first curve. Again the observations are plotted and the positive maximum falls at the same place on the circle and therefore at the same place on the commutator. The two maximum points are at about 65° and 245° from the positive brush and the two potential differences are 168 and 456 volts. Their sum this time is 624 volts, a little less than with no load. With the highest load carried the brushes were rocked backward about 5° farther, and the lead was then about 15°. The extreme potential difference obtainable this time did not exceed 600 volts. So far as can be discovered from these curves the neutral plane remains fixed, while the brushes move around the commutator to adjust to a constant current. I find no evidence in them that the forward movement of the brushes to control the current causes the neutral plane to move with them. As the brushes advance with a diminishing external load they put between them and the neutral plane an increasing number of armature turns generating counter-electromotive force, and it is a striking fact that when the field coils are not cut out, the back-turns on the armature cut down the potential difference between the brushes not by a counter-magneto-motive force apparently, but by counter-electromotive force; for the maximum potential difference to be found on the commutator is no less on no load than on full load, showing that at least as many lines of force traverse the armature core with the brushes far forward and with many back armature turns as with the brushes in the position for maximum load and with the back turns reduced to a minimum.

Three methods of governing.

Assuming still practically constant speed, we next inquire into the methods employed to maintain a constant current without appreciable sparking by rocking the brushes around the commutator cylinder.

In one machine the brushes are moved automatically by means of a small electric motor and at the same time field coils are successively cut out as the brushes rock forward with a light load. A pair of brushes is used on each side and they are kept at a fixed distance apart. By these combined means the machine can be run on short-circuit with the normal current and without sparking.

Another system leaves the field coils constantly in circuit but employs two pairs of brushes and varies the angular distance between the members of each pair when the brushes are moved. The movement of the brushes is effected mechanically in response to any change in the main current till the current is brought back to the normal value. In these machines the spread of each pair of brushes, or what is sometimes called the overlap of the brushes, is lessened as they rock toward the polar centers. Very satisfactory results are secured in this way.

In the third class of machines only one pair of brushes is used, which lap over about two or three commutator sections, and the regulation of the current is effected solely by the movement of this one pair without change of overlap and without disturbance of the ampere turns on the field. The brushes are moved mechanically by means of an automatic regulating device. No less satisfactory results appear to be secured by this method than by the others, while the mechanism as a whole is somewhat simpler.

I have described these three methods for the purpose of pointing out their bearing on the theory and design of closed-coil Gramme rings for constant currents. The important question is not how to get the necessary electromotive force with such a dynamo, but how to vary that electromotive force in response to the varying demands of the external circuit, without injurious sparking at the brushes.

The electromotive force is controlled in all three of these methods by rocking the brushes, and the other differences in the devices are made necessary for the suppression of the sparking. This brings us to a consideration of the most intrinsically interesting topic of the paper, viz., the conditions necessary to suppress sparking and the features of design required to furnish them.

Suppression of sparking.

If we assume that the armature is well-balanced electrically and magnetically and that the brushes have a proper bearing in contact with a smooth commutator, the conditions required to commute the current without sparking are known to be as follows: With a two pole dynamo, the current is divided through the armature, one half going from brush to brush through one side, and the other half through the other side. Hence when an armature coil is carried past the brush it is transferred from the one circuit through the armature to the other, and at the same time the current through it reverses its direction. This constitutes the act of commutation. But the sudden decay of a current through a coil in one direction and its growth to an equal value in the other gives rise to aa electromotive force of self-induction opposing the change. This electromotive force will prolong the flow of the current on one side of the brush and will oppose its rise on the other side. Hence if the coil is short-circuited by the brush lapping over the two consecutive commutator segments to which its ends are connected, even when the coil passes the neutral plane of the dynamo, the electromotive force of self-induction produces a local current through this coil; and when the one end of the coil slips past the brush and becomes a part of the other half of the divided circuit the current which should reverse through it meets the opposing current and breaks over the gap to the brush with a spark. Hence the commutation must not take place at the neutral plane but in advance of it, and in a field where the induced electromotive force in the coil shall be just sufficient to offset the self-induction, and in addition reverse the current in the coil while it is passing the brush or pair of brushes, and cause it to grow to the normal value at the instant when one end of it passes out from under the brush. The induction from the field must be sufficient to bring the one current to zero and to set an opposite one of equal value flowing in the coil during the time it is under the brush. Then the commutation will be sparkless.

Now if the current is kept constant in strength the field induction required to accomplish the results described is aproximately the same whether the coil is short-circuited at one angle or another in advance of the neutral plane. It would appear at first thought that, unless the induction in every part of the field from the neutral plane to a point nearly 90° in advance of it is substantially uniform, terrific sparking must result when the brushes are shifted far forward to vary the electric pressure to suit the requirements of the circuit; for if the induction is in excees of the requirements to accomplish the result described in the commuted coil then a current will circulate through it during the short-circuit, and the rupture of this on leaving the brush will cause sparking. I have illustrated this action in the following manner: Separately excite the field magnets of a machine which can run on short-circuit even with a forward displacement of the brushes without sparking. Then leaving the armature on open circuit rock the brushes forward; the sparking will increase with each advance till it becomes terrific and endangers the machine. The induction to which each coil is subjected in an excited field produces a large current in it while it is under the brush since there is less self-induction in the coil to offset the induction from the field than there is when the machine is self-excited and working in the normal way. There is another reason to be described later.

Considerations of this kind have led some writers to say that sparkless commutation for any position of the brushes can be accomplished only when the induction in the field is made uniform. The Statter constant current machine in England is made on this principle. Portions of the poles piece are laboriously cut away at such points as to make the density of the lines of force entering the armature over a given angle equal. Of course a machine built in this way will permit of shifting the brushes through a considerable angle in order to vary the potential difference without introducing sparking.

But while a uniform field accomplishes the result, no such uniformity is required; the same result may be secured in other ways. The first method already described weakens the field when the brushes move forward by cutting out ampere-turns in the field magnet. This reduces the induction to the proper amount at each point without changing the overlap of the brushes. It is made necessary by the very high saturation of the armature core in this machine. It has the advantage of greater economy with small loads, because field resistance is cut out, but it requires a more complex arrangement of parts on the machine than suffices for the mere movement of the brushes.

The second method diminishes the overlap of the brushes as they are rocked forward. In the first place this has the effect of diminishing the time allowed for the reversal of the current, but it also diminishes the number of turns of wire in the coil or coils included between the two parts of each brush. The curtailed time interval increases the self-induction of each convolution of wire because it increases the rate of charge of the current in the coil undergoing commutation; but this increase is counterbalanced by the diminution in the number of turns of wire short-circuited by the brush. Hence, the total self-induction during commutation remains not far from con-

1. Read before the Franklin Institute, December 26, 1893.

stant. When the brushes shift forward into a denser field, however, the diminution in the overlap decreases the number of turns of wire included between the pair of brushes composing either the positive or the negative, and so cuts down the total field induction in those coils during commutation to the amount required to suppress sparking. The overlap of the brushes must therefore be inversely as the induction in a coil under the brush is to different parts of the field, for the presence of the pole of the armature at any point reduces the induction. This point is a complicated one, and needs further experimental study.

But in the third class of machines the overlap of the brush is constant, and the field is not weakened by cutting out coils on small load. Neither are the pole faces cut away to produce uniform induction. Attention is given to the thickness of the pole pieces so as to avoid unnecessary crowding of the lines of force toward the central portions. It is also desirable to avoid thinning of the polar horns lest they become saturated. In the old Sperry machine, which I have investigated quite carefully, each pole piece is cut quite in two. In fact, as is well known, the field has four cores. At the same time the horns or pole tips are rather blunt. But this machine shows the violent sparking when separately excited, with the brushes far forward and the circuit through the armature open. The induction around the armature is not uniform, but the sparking is small for any position of the brushes with the normal current. The brush bears on about three commutator segments. I refer to this machine as an illustration of the class and not as a model of excellence. It is no longer built.

In this machine the induction to which a coil is subjected near the brush is not the same in different parts of the field, but diminishes as the brushes are rocked forward, the current being kept constant. With the exploring coil before described and the two extra brushes bearing on the insulated copper ring and the fiber collar with brass segment respectively, the external circuit connecting the two small brushes was carried through a d'Arsonval galvanometer in shunt. The two extra brushes were attached to the two main brush holders but were insulated therefrom. With one brush making contact with the small brass segment two and then three commutator bars in advance of the upper main brush, the following deflections were obtained with the galvanometer from maximum to minimum load, the steps being about equal:

Deflections, 2 Segments.	Deflections, 3 Segments.
26	63.5
24	56
22	49
20	41
18	34
16.5	32
13.5	
12 5	28
10.5	

The steps were not the same in the two series of observations. No trouble was found in obtaining a steady deflection of the galvanometer, the dynamo making about 1,200 revolutions per minute. The exploring coil was therefore subject to a diminishing induction near the brush as it moved forward with the brush toward the center of the polar surface.

A similar series of experiments made on an old Gramme machine of 3,000 or 4 000 watts capacity, built at the University of Michigan in 1876–7, gave a different result. The measurements were made by simply connecting a third brush to the upper brush holder and measuring the potential difference between it and the main brush in different parts of the field. The actual induction to which the armature wire is subjected in different parts of the field and at the same distance of two commutator bars from the main brush is thus measured.

The following table contains one series of observations:

No. of Observation.	Current in Amperes.	P. D. Between Main Brushes.	P. D. Between Main and Third Brush.
1	9.5	101	4.9
2	9.5	170	5.1
3	9.5	145	5.5
4	9.5	127	6.2
5	9.5	111	6.5
6	9.5	77	7.7
7	9.5	62	7.8
8	9.5	51	7.7
9	9.5	47	7.4

In this case the induction increases throughout the larger extent of the movement of the brush. But in this machine the knee of the charactistic curve is reached at about 13 amperes, while in the other machine it is found at 7 amperes. The armature reaction in this older machine when run at 10 amperes is relatively less than in the other one run with the same current. This is further evident from the fact that with the old Gramme run at 10 amperes an increase in the current, due to lessening the external resistance, is always accompanied by an increase in the potential difference between the main and the third brush; while with the 10 light Sperry machine and others with similarly saturated field an increase in the current when the brushes are fixed decreases the potential difference between the main and extra third brush. The reason is this: If the field is saturated, but not the armature, an increase in the current does not appreciably increase the field but it does increase the armature reaction, and so cuts down the total potential difference between the main brushes as well as between one main and a third brush; while with an unsaturated field and a magnetically weaker armature, an increment of the main current produces a greater increment in the field than in the armature reaction. With the same old Gramme machine run at about 18 amperes, an increment in the current produced a decrease in the potential difference both between the main brushes and the main and third brush. The armature reaction then became relatively larger than the increase in the field magnetism. But this old machine exhibits perfectly the property of governing by rocking forward the brushes on a diminishing load, with no more sparking in one position of the brushes than in another.

Hence it is clear that for practically sparkless commutation it is not necessary that the induction near but under the brush shall be a constant. The effective means by which, with constant current, the brushes can be set in any plane around the commutator cylinder is the reactive effect of the armature. This fact is brought out quite clearly by plotting the integrated potential differences between the upper or positive brush and the third movable one as ordinates to a horizontal line. The data are the same as were employed to plot the first curve in Fig. 1. If Fig. 2 is examined a decided flattening in the curve will be found at 180°, the position of the negative brush. The same flattening may be seen at 0°. All curves, plotted with data obtained at different loads show the same diminution or stay of the inductive process near the poles of the armature. The armature at these points paralyzes the field. As the poles of the armature move around they sweep away the lines of force of the field, and only enough remain to produce an electromotive force competent to offset the electromotive force of self-induction and in addition, cause the newly directed current to grow to its normal value as the coil passes out from under the brush.

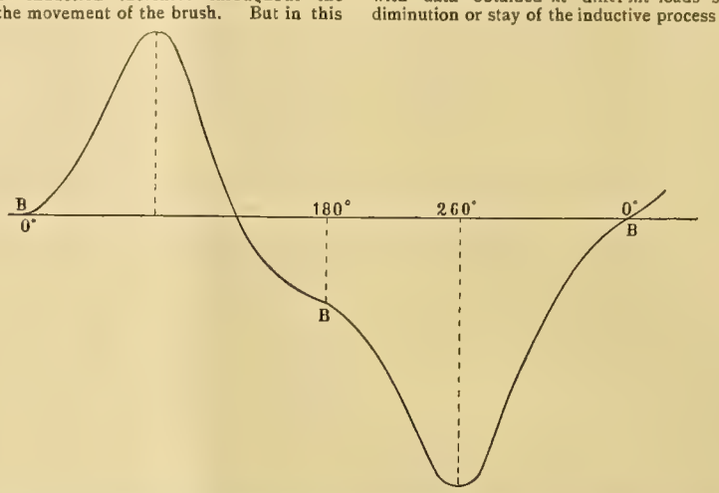


FIG. 2. THE THEORY AND DESIGN OF THE CLOSED COIL CONSTANT CURRENT DYNAMO.

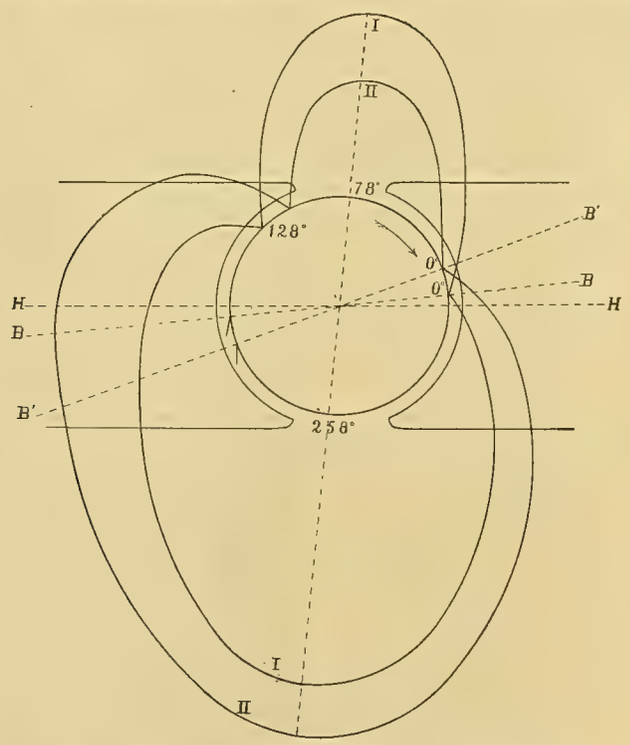


FIG. 1. THE THEORY AND DESIGN OF THE CLOSED-COIL CONSTANT CURRENT DYNAMO.

This reactive power of the armature may be utilized to effect approximately regulation for constant current without brush-shifting. But for this purpose the load cannot be a maximum. The poles of the armature must be far enough forward to produce increase of magnetic leakage. As an example of what I mean, a 40 light machine had its brushes locked in such a position that it maintained 30 lights with 10 amperes current. Ten lights were then cut off, and then ten more, with but small increase of sparking, and the ammeter showed an increase of current from 10 to 12 amperes only. A change of two amperes is within limits possible for practical lighting. The machine was then completely short-circuited by placing a large bar of iron across its terminals without dangerous sparking. This means that the characteristic of the machine beyond the crown of the curve approached a vertical line, the ideal characteristic of an automatic constant current dynamo.

The conditions requisite for sparkless commutation of a constant current machine are therefore quite clearly defined. The self-induction of the short-circuited coils must nearly balance the field in all positions of the brushes. Both Mr. Esson, in a paper before the British Institution of Electrical Engineers,[1] and Professor Ryan, in a paper before the American Institute of Electrical Engineers,[2] lay down the condition that the brushes must be kept under the pole-faces in order not to enter the weakened field between the pole corners. And yet I have seen constant current machines working with the brushes beyond the extreme tips of the poles with no increase of sparking.

I do not regard this condition as absolutely essential since at maximum electromotive force the brushes may be moved through a considerable angle without appreciable change in sparking.

Professor Ryan states in his paper above referred to that "the magnetizing force impressed by the field ampere turns must be uniform at all points between the pole faces." This condition is favorable to sparkless commutation but not essential. It has to do with the area of the sparkless position of the brushes for any given load. If the field is fairly uniform, this area will be about the same in different parts of the polar faces; if the field is far from uniform, sparkless commutation may yet be secured, but a smaller variation in the current will produce sparking than when the field is uniform for the sparkless area on either side of the brush with a given external resistance is then much reduced. The region controlled by the armature poles is more limited in extent than when the field is uniform.

It follows that the single magnet type of field is not suitable for a constant current machine. This fact was remarked upon by Mr. Esson. For a two-pole machine the double magnet type is to be preferred. If then the iron is reduced at the back opposite the middle of the polar surfaces, and the poles are thickened and rounded off rather blunt at the ends to prevent saturation, the field induction will be sufficiently uniform without the necessity of resorting to the chopping-away process applied to an English single magnet machine described in Slingo and Brooker's "Electrical Engineering."

1. London *Electrician*, March 21, 1890.
2. Proceedings, Vol. viii., p. 465.

Quoting again from Professor Ryan: "The air-gap is made of such a depth that the ampere turns required to set up the magnetization through the armature, without current, and for the production of the highest electromotive force, that the machine will be called on to give, shall be a little more than the armature ampere turns when it furnishes its normal current. Then as long as the brushes are kept under the pole faces, the non-sparking point will be wherever the brushes are placed. This will be the case whether the armature is or is not saturated." Again: "The impressed field ampere turns are in excess of the armature ampere turns by that amount which is just sufficient to produce a weak positive field that will reverse the current in the coil when its terminal bars at the commutator pass under the brush." This latter statement appears to be borne out by the data given, but the machine experimented upon was one giving a maximum of only 35 volts and 22 amperes, and its performance can scarcely be considered a sufficient guide for the design of machines required to furnish several thousand volts and a current of from 9.5 to 10 amperes. Again I have known a 40 light machine converted into a 50 light without any change in the field whatever. The armature either contained more iron or was wound with a larger number of turns of wire. Both methods have been followed without effect on the sparking. The first method leaves the armature ampere turns the same; the second increases them 25 per cent. If the relation pointed out by Professor Ryan holds in the first armature, it cannot also hold in the second with such a material increase in armature turns.

Further, if this relation does hold there still remains unanswered the question of relative cross-section of iron in armature and field. Shall the core of the armature be saturated or not? Mr. Esson says that 17,000 lines per square centimeter is the best practice in England for constant potential machines.

I know of one constant current machine in which the armature core is forced well up toward the highest saturation obtainable in a dynamo machine. It is able to produce very high electromotive force, but it does not govern sparklessly by means of a single pair of brushes. Two other types of machine of which I have data work with about 11,000 lines per square centimeter in the armature. In both of these recent changes are along the line of increasing iron and decreasing copper in the armature. I have explicitly advised the use of more iron in the armature for two years. One manufacturer recently told me that he is now following my advice with most gratifying results. With the same number of turns on the armature, the output is greatly increased. To what extent the iron in the armature can be increased is an open question. It has now been carried beyond a cross-section equal to 75 per cent. of the wrought iron in the field cores. If increased cros -section of the core introduces sparking, this can be avoided by increasing the number of bars on the commutator so as to decrease the self-induction in the section under short-circuit by the brush. Indeed, if the output is kept the same, increase of iron decreases turns of wire, and to that extent decreases self-induction. In a machine with two pairs of brushes the effect is to diminish the angular embrace of each pair.

It is interesting to compare two machines of almost exactly the same capacity, but differing widely in relative core section and armature turns. Let the two machines be represented by A and B. The data of the two are given in the following table:

Machine.	Total Volts.	Rev. per min.	Segments in commutator.	Turns per segment.	Total turns	Cross-section of iron, sq. in.	Lines per sq. in.
A	2,900	1,000	132	36	4,752	26.5	70,800
B	2,800	875	120	72	8,640	14.0	79,000

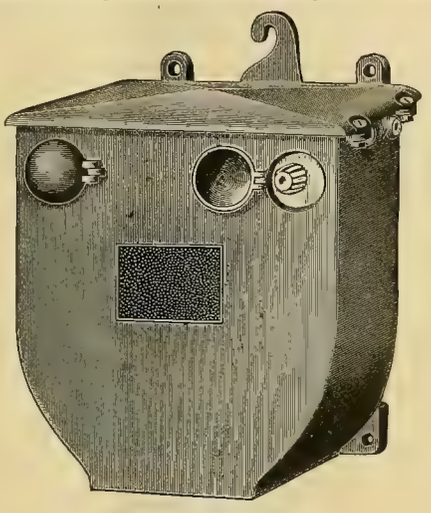
The maximum number of lines of force running through the armature of the A machine is 3,650,000; of the B machine, 2,213 000. The two machines are designed for the same current of a little under 10 amperes. The ratio of the ampere turns on the armatures of the two is nearly inversely as the cross section of their iron cores. The ampere turns on the B armature is 82 per cent. greater than on the A armature. It is not probable that the field ampere turns on B is 82 per cent. in excess of those on A. Unfortunately those particular data are lacking, but the magnetic circuit of A is quite as good as that of B. It does not appear at all probable, therefore, that Professor Ryan's rule applies to both machines. It is gratifying to our national pride that American designers have successfully carried the Gramme ring constant current dynamo to an output far beyond what some foreign electricians with more theory and less practice in this direction still declare to be impracticable. The writer of a series of articles now running in the London *Electrical Review*[1] says: "Beyond about 1,000 volts it is found, in general, to be impracticable to work a closed-coil armature, for, either there will be a wasteful lead, or there will be vicious sparking under the brushes, or the current will flash from strip to strip, and will destroy the commutator." . . . . "It seems more than probable that machines of this kind will not stand any serious alteration of load if worked at higher voltages, owing to the great range of lead which would be required, and the consequent sparking and flashing over." Again he says: "There is of necessity a large armature reaction in certain forms of arc light machines, and when this is the case the brushes would require to be shifted right into the center of the pole arc before sparking would cease, if there were very many turns on each section. The wastefulness of this practice consists in the large number of back-turns and cross-turns which it involves." But in the face of such declarations as these a large number of American machines are now running at an output of 9.6 amperes, and from 5,000 to 10,000 volts. A very considerable number of closed-coil Gramme rings giving 5,000 volts are in actual use without breakdown and without any of the fatal drawbacks predicted by the writer quoted.

1. *Electrical Review*, Aug. 25, 1893.

The design of closed-coil Gramme rings for high potential arc lighting has thus far been limited to the two-pole type of field-magnet. This involves the maintenance of higher speed than engineers find desirable. The conditions of present practice and the requirements for the immediate future demand a new departure in this class of dynamo design. All indications point toward a multipolar machine of about 50 kilowatts capacity and slow speed. The armature will contain a liberal amount of iron, much larger than would be found desirable for constant potential machines. Such a dynamo is already in demand, and it will find an immediate field for the lighting of large cities.

A New Transformer.

The improvement of the last few years in transformer construction has been most marked. In the Packard transformer an attempt has been made to incorporate all of the



A NEW TRANSFORMER.

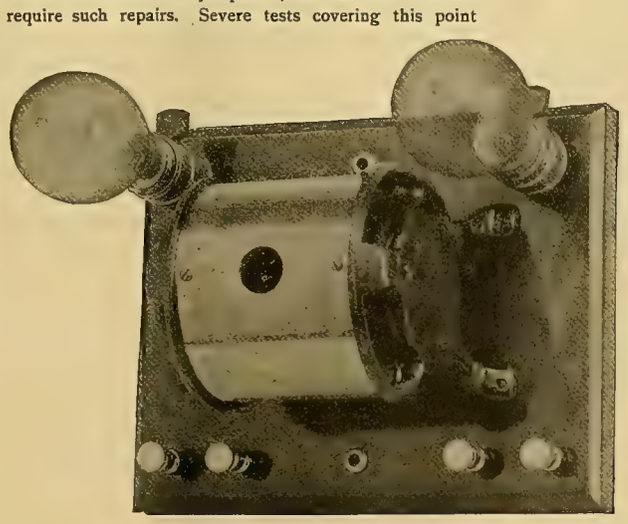
improvements of recent years in transformer construction, and at the same time to avoid the mistakes which have been made in many cases in attempting to secure desirable results. The innovation of the oil transformer was one of the many attempted improvements, and it has its advantages. Perhaps the most radical change has been in the construction of transformers with removable coils, but the efforts of the manufacturers of the Packard transformer from the start have been to produce not a transformer that can be easily repaired, but one that will not require such repairs. Severe tests covering this point have shown almost conclusively that the Packard transformer will not burn out under normal conditions. The much desired results seem, therefore, to have been attained. Careful tests extending over a considerable period have demonstrated the attainment of the highest results as regards efficiency and regulation in this transformer.

By reference to the accompanying cut it will be observed that in mechanical construction it is neat and compact. The fusing arrangement is most convenient and complete. Throwing back the two round covers or lids shown in the cut discloses two porcelain plugs, which carry the transformer fuses. These can be withdrawn and refused or another plug inserted almost instantly without the use of any tools or the least danger to the operator. In the construction of the coils the circular or ring form has been followed, and care has been taken to proportion the windings so that the best possible results will be secured. The point in which the excellence of the Packard transformer undoubtedly lies, however, is in the insulation of the coils.

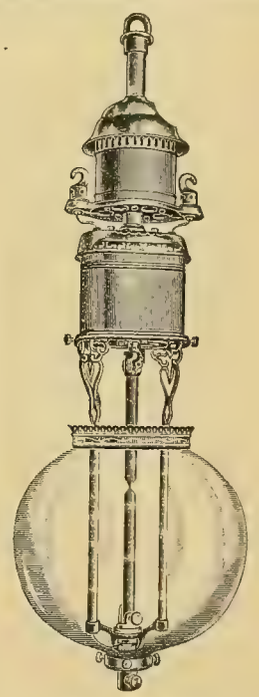
The Electric Appliance company of Chicago, has taken the general western selling agency for this type of transformer, and is introducing it extensively to the western trade.

Acoustic Synchonizer for Alternating Machines.

With the great use of alternating current machines and with modern ideas of central station practice, it is frequently desirable to run alternators—single-phase and polyphase machines—in parallel. Although alternators have not hitherto been run in parallel as a general thing in this country, the practice is not infrequent in Europe, where it has been made the subject of much study. The operations of alternators in parallel is, however, receiving more attention here, and a device to indicate in the most delicate, yet effective manner, the exact point of synchronism in speed and coincidence of phase of two alternators has become a necessity. The requirement is being met by the acoustic synchronizer which the General Electric company has recently brought out. It consists, as shown in the accompanying illustration, of a cylindrical iron case with an aperture in the side, each end being closed by flexible diaphragms, each of which has, opposite its center, the pole of an electro-magnet. In using this device one of the magnets is connected in circuit through a transformer with each of the machines to be run in synchronism. The current is then turned into the magnet coils, and the diaphragms emit a loud clear note. As the machines approach synchronism, the notes from the diaphragms approach closer in period and begin that loud, periodic sound known in music as beats. As the two machines more nearly approach synchronous speed, the beats grow slower and slower, until finally, the diaphragms fall into unison and each gives out the same low, clear note. At this moment, which is sharply marked, the switch connecting the two machines should be thrown in. So sensitive and distinct is the indication of approach of synchronism, that it is possible to throw two machines together with hardly a quiver upon the ammeter in actual circuit. The superiority of this acoustic apparatus over the old phase lamp device is noticeable. It is much more sensitive, indicating distinctly the small differences from synchronism, which the phase lamp fails to detect.



ACOUSTIC SYNCHONIZER FOR ALTERNATING MACHINES.



KESTER ARC LAMP.

Kester Arc Lamp.

In the accompanying illustration is shown the improved Kester arc lamp, manufactured and sold by the F. P. Little Electrical Construction & Supply company, Buffalo, N. Y., and which has many interesting features. Much attention has been given in the construction of this specialty to produce a lamp which would prove particulary economical in the consumption of current. This has been accomplished by using a superior feeding device, insuring a steady, uniform arc, which is constantly maintained.

The Kester lamp is of neat form, ornamental, highly finished, made of the best material and heavily lacquered. It may be placed upon any incandescent lighting system and upon the same system of wiring with incandescent lamps of from 50 to 500 volts. The company now possesses satisfactory facilities for turning out these lamps, and the inventor, J. F. Kester, personally inspects each lamp before it leaves the factory.

Ansonia Electric Company's Affairs.

As predicted in the WESTERN ELECTRICIAN of November 18th, the proposal of the Ansonia Electric company to effect a settlement of its affairs has not been accepted by the company's creditors. The company has accordingly issued the following circular letter:

After careful consideration the directors of the Ansonia Electric company have decided to withdraw their offer of compromise made to the creditors some months since of paying sixty cents on a dollar, and they do hereby withdraw same. The reasons for this decision are as follows:

The proposition was not accepted promptly by all the creditors, and on account of this the concern has almost entirely lost the benefit of the fall trade, which, in the electrical supply business, is altogether the best of the year. If the compromise had been accepted at once when made, the directors believe that it could have been successfully carried out.

In addition to the above the business has become to a considerable extent disorganized in Chicago, for the reason that the assignee by orders of the court has been obliged to conduct the business within quite narrow limits, so that at the present time the Chicago branch is not in nearly as good shape to continue as a going business as it was at the time the proposition was first made.

The directors are now considering in the interest of a proposed reorganization the matter of making another offer to the creditors, and if, as hoped, some financial assistance outside of the company is obtained, another proposition will be laid before the creditors. This will of necessity be lower, but it is hoped to make it in the shape of a cash offer.

A Pacific Coast Tale.

The *San Francisco Examiner* is responsible for an account of the adventures of two civil engineers on the peak of Roundtop, a mountain near the boundary line between California and Nevada. They found a rude shelter, which they kept closely during a storm of three days' duration. They were destined to be strangely disturbed, however, as the chronicler tells:

From the ground a short distance away came a hissing sound, as if the cook of nature were frying half the the mountain. The hissing was continuous, but varied in intensity. Mr. Fairfield cautiously approached the place whence the sound came. He found that the noise seemed centred in a little jut of rock not bigger than a chair. He stepped upon the rock and instantly received an electric shock, not so severe as to hurt him, but sufficient to make every part of his body tingle. He stepped from the rock and instantly the electricity left him. One foot from the rock it could not be felt. His assistant then stepped upon the rock. The shock was too much for him. Evidently he is much more sensitive to electricity than Mr. Fairfield, because it hurt him. He felt pains all over his body, and every hair stood straight from his head. He stepped quickly from the rock and would not try the experiment again.

Telephony in the Antipodes.

A Melbourne paper contains an interesting account of the introduction of the telephone among the sheep raisers in Australia. Many sheep stations are connected in this way. So long as a squatter keeps his telephone on his own property he is quite within his rights, but if his wires cross a public road he renders himself amenable to the law, which forbids a private person to erect a telephone or telegraph, the monopoly being reserved for the government. The postmaster-general does not wish to prohibit telephones under such circumstances, and he has therefore had regulations prepared, which have been passed by the governor in council, charging a license fee of £1 per mile per annum for the first four miles, and after that 10s. per mile, the feet, however, in no case to exceed £7 per annum. The height at which the wire must be carried across roads is specified, and it is also provided that in no case shall a fee be charged or accepted for the use of the line.

Searchlight for Sandy Hook.

It is said that within a few days extensive experiments with an electric searchlight will be made at Sandy Hook. The light to be tested is as large as any in use. The experiments are intended to show the value of a searchlight for coast defense purposes. The mirror will be of sixty inches working diameter. The lamp will be of the horizontal arc type, self-focussing and capable of adjustment either automatically or by hand, Its arrangement is such that either a convergent or divergent beam may be projected. It is stated that a German firm—probably Schuckert & Co.—will furnish the projector.

New Telephone Service for Chicago.

The Chicago Twin Wire Long Distance Telephone company, which succeeded in obtaining a franchise last April, by the terms of which it was not permitted to begin construction work until December 1st, so as to prevent blocking the street during the period of the World's Fair, is ready to begin operations. It is given out that the company is making extensive preparations to install 10,000 subscribers' telephones and 5,000 public instruments. An improved messenger service will be operated in connection with the public telephones. The company has a capital stock of $5,000,000. The president is Edward J. Judd and the secretary Arthur P. Hunnermann.

Electric Wire Requirements in Chicago.

The Chicago Fire Department has issued a little pamphlet containing the rules and requirements the department for the installation of wiring and apparatus for electric light and power. It is intended for the guidance of architects and builders and is similar in purpose to the book issued by the Chicago Fire Underwriters' association, although the books differ in some requirements.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 15. — Edward Lauterbach appeared before the rapid transit commissioners last Wednesday with an assurance from Frederick Uhlmann, Adolf Ladenburg, Jacob Ruppert, John Schaefer, Simon E. Bernheimer, and their associates interested in the East river bridge, the Brooklyn elevated railroad system and the proposed cross-town elevated road in this city that they would bid for the franchise of the independent elevated system, as laid out by the commissioners. He said his clients were ready to acquire the franchise if it could be offered. They would, of course, expect reasonable terms of sale, of which they felt themselves prepared to judge from a somewhat large experience in this class of enterprise. Mr. Lauterbach submitted his proposition at some length and said the capitalists whom he represented were convinced that the only system practicable just now for rapid transit in this city was an elevated system.

In considering the work now in hand by the commission, Mr. Lauterbach said that the engineer of the Brooklyn road, George B. Cornell, had gone over the commission's routes and plans with Engineer Bogart, and had made a report thereon, which showed that the undertaking was entirely feasible and practicable. "If we can secure this franchise on terms within reason," Mr. Lauterbach went on, "we will pledge ourselves to build the road. The commission may feel assured if the terms be reasonable, of an honest, bona fide bid from men acquainted with the possibilities and risks of such an enterprise. We are only astonished that the Manhattan company did not accept the terms proferred by the commission. Should we succeed in getting the franchise, we can offer to the public the advantage of a transfer system by which passengers may be carried to or from Brooklyn for a single fare." In reply to a question by Commissioner Porter, Mr. Lauterbach said his clients were willing to accept the routes already laid out, but would insist upon an option on any possible East Side extension above Forty-second street. H. G. Hillam failed to produce or name the capitalists for his double-decked tunnel scheme. Mr. Steinway insisted that he should give the commission assurances from capitalists before his scheme should receive consideration. He said he would try to present the required assurances at the next meeting of the commission.

The Atlantic Avenue Railroad company has taken steps to protect pedestrians from injury and death by the trolley cars. Thirty wire cradles were last week attached to cars with the hope that they will save life. The cradle runs under the car and is attached to the fender in front of the wheels. Hanging from the platform six inches above the track, and extending the full length of the car, is an iron bar covered with rubber. When the bar strikes an obstruction the cradle is released and it falls instantly, catching up the obstruction. The company intends to equip all its cars with this device as speedily as possible.

The work of laying the signal cable of the Third avenue cable road was commenced some time ago. The strands are of thick wire, laid in a pipe built in a conduit east of the west tracks of the roadbed. There are three sections of the signal cable. That between Bayard and Sixth streets has nine strands. That between Sixth and Sixty-fifth streets has ten strands, and thence to Harlem are strung eleven. The company will have wrecking wagons, built like the fire insurance patrol wagons, stationed at four points along the road to expedite repairs in case of accident. These wagons will be fitted with apparatus that will establish instantaneous telephonic communication with the power stations in any emergency. Signal boxes will also be placed in the manholes north of each even numbered street. Each conductor will have a key to the boxes, and by turning a crank in the box can transmit signals to the power stations for the machinery to be stopped or started.

Mayor Charles A. Schieren sent his first annual message to the Brooklyn Common Council January 8th. Regarding the trolley situation he said: "In regard to the danger to life and limb from the operation of the trolley cars I desire at the present simply to say that the matter will have my serious and earnest attention until means are devised for the due protection of the public."

Another master workman's place is vacant in the Navy Yard, and, as usual, a competitive examination will be held to fill it. This time the place is that of master electrician at a salary of $6 a day. The examination will be held in the yard on Tuesday, January 23d, and the rules governing the application and the examination are of the same kind as those which have heretofore prevailed in these examinations. It will be open to citizens of the United States who can give evidence of experience in conducting this kind of work. Applications must be addressed to the commandant, Navy Yard, New York and must not be delivered to him later than Monday, January 22d.

Edward Gardner of Brooklyn was held in the Jefferson Market Police Court last Thursday on charges of larceny. The charge of larceny is the first of its kind on record in this city, being that of stealing electric power. Gardner and his brother-in-law have charge of the exhibit of Roulette Cycle company of Coventry, England, at Madison Square Garden. Frank Martin, the electrician of the garden, observed on Wednesday night that the wheels of a bicycle hanging above Gardner's booth were being turned at a rapid rateby some unseen power. On investigation he found that the electric light wires had been tapped, and were connected with a small electric moter, which kept the wheels in motion. It it said that in a somewhat similar case the Supreme Court in Buffalo sustained a charge of larceny about a year ago. W. F. O.

Washington, D. C.

WASHINGTON, January 15. — Bids were recently opened at the war department for an electric search light. The specifications included one improved search light complete with a mirror about 60 inches in working diameter, supplied with a horizontal arc lamp, the apparatus to be furnished with a suitable governing mechanism, one voltmeter, one amperemeter, one switch, one safety fuse, one series rheostat with switchboard, one dynamo of sufficient capacity to produce an intensity of light given out by the projector of about 200,000,000 candle power, 500 feet of cable, No. 000, with the necessary insulators, poles fastening and connecting materials, one steam engine arranged for direct coupling with dynamo of 20 horse power, or of sufficient capacity to produce the electric current as specified, and one water-tube marine boiler of 25 horse power, or of sufficient capacity for the requirements of the power plant as specified. There were only three bids entered for doing this work for the Government. These were from the Fisher Electric company of Detroit, Mich., the General Electric company, Washington, D. C., and Fred Tischendoerfer. It is probable that the bid of the last named will be accepted. The award will be made in a few days.

A short time ago Philip Walker, representing E. M. French & Co., electrical engineers, made a request of the district authorities that his clients be given permit to place 6-inch terra cotta pipes under the streets and sidewalks in the vicinity of the Central Union Mission, in the cellars of which Messrs. French & Co. intend to place a steam boiler and engine and the necessary plant for generating and distributing electric currents for the purpose of lighting the stores and other rooms in the buildings of the squares mentioned. When the commissioners considered the question of granting the permit, a doubt arose as to the legal powers of the commissioners to grant such a permit. The attorney for the district, S. T. Thomas, holds that the commissioners have no power to grant the desired permit. The opinion continues as follows: "The law in regard to electric wires for telegraph, telephone and electric lighting purposes is confined to

existing companies operating in the District of Columbia. As to such companies the commissioners may allow them to place their overhead wires underground under such reasonable conditions as the commissioners may prescribe, and also to extend their wires underground whenever in the judgment of the commissioners the public interest requires it." It looks very much as if "existing companies" have a monopoly and need stand in no fear of competition. The commissioners have sent an order to the United States Electric Lighting company, which compels that corporation to place all its overhead wires on Fifteenth street, between F and H streets northwest, underground.

All future incorporators of street railways in the District of Columbia, in the preparation of their charters, will have to conform to certain prescribed regulations laid down in a model bill just prepared by the commissioners of the district. The feature about this measure that is of most interest to electrical readers, lies in the fact that all future electric railways established here must furnish and maintain such electric lights along its line as the authorities may direct without cost to the district government, but no overhead wires shall be constructed or used within the limits of the city of Washington.

Electrical Workers' Union No. 26 of this city gave an entertainment at its hall a few nights ago to the members and their families and friends. On January 24th this union will give a free lecture on electricity for the benefit of its members and for the benefit of the public in general.

The secretary of the navy has appointed a board consisting of Commander Washburn Maynard, Lieut. J. D. Murdoch and Prof. O. G. Dodge to inspect the electric plants at the New York and Norfolk navy yards. There are three separate electric plants at the New York yard—one in the construction department, one in the engineering department, and the third used to supply the electric lights for the yard. There are also two plants in operation at the Norfolk yard. The department is of the opinion that the same results could be accomplished at a much reduced expense if there were but one electric power house at each yard. Commander Maynard's board is to report on the feasibility and desirability of making the suggested changes at both yards. It is desired to simplify the system and reduce the expense of operating the electric appliances, if it can be done without interfering seriously with the naval work now in progress at the two yards.

A board composed of Commander T. F. Jowell, Lieutenant Commander Arthur Dunlap and Lieut. Stokely Morgan, has been appointed to examine applicants for appointment as electrician at the Washington navy yard.

M. Stanley Hollis, United States consul at Mozambique, reports that material has arrived at the port of Chindo for the transcontinental telegraph line, which already runs from the Cape of Good Hope to Mashonaland. It is the builders' intention to carry the line through to Cairo, but in the present state of affairs in East Africa it is considered doubtful whether it can reach beyond Uganda. D. C.

PERSONAL.

Frederic A. Pullman, president of the the Pullman Electric company, has been elected secretary of the Railway Equipment company.

NEW INCORPORATIONS.

Harbor Light & Power company, San Francisco, Cal.; capital stock $100,000; to deal in electrical inventions and machinery; A. Devoto, San Francisco, Cal.

FisherElectrical Manufacturing company, Detroit, Mich.; capital stock, $50,000; to manufacture and sell electrical lighting plants, electric and steam engines and dynamos and electrical machinery, etc.

Elmwood Electric Light company, Peoria, Ill.; capital stock, $30,000; to run and operate a steam electric power station and to buy and sell electric current and apparatus, and to furnish heat, power and water.

ELECTRIC LIGHTING.

Mancelona, Mich. is to be lighted by electricity.

Saugatuck, Mich., merchants are talking of putting in an electric light plant to furnish light for their places of business.

It is stated that an electric lighting plant of 2,000 16 candle power lamps capacity is being installed in the palace of the king of Korea.

Batavia, N. Y., has decided to install an electric lighting plant with a capacity of 120 2,000 candle power lights. Proposals are wanted for the electrical machinery and for 85 arc lamps.

Sealed proposals will be received at the office of the public lighting commission, Detroit, Mich., until January 30th, for furnishing the labor and material for the construction of the necessary engines, boilers, dynamos and arc lamps for the lighting plant to be erected by the city of Detroit.

Propositions from two electric light companies were received by the city council of Ames, Ia., for public lighting at its last meeting. The matter is under consideration.

A dispatch from Rome states that on January 8th the cable supplying the current for the electric lights on the Via Nazionale and the Corso was cut by an unknown culprit.

The contract for the electric lighting of Madisonville, O., has been let to the Fort Wayne Electric company. Sixty 1,200 candle power arc and 800 16 candle power incandescent lights will be used.

The mayor of Springfield, Ill., has appointed a committee to look into the matter of electric lighting. There is a strong feeling in favor of a municipal plant, but reasonable propositions will be entertained from private companies.

In the spectacular production, "Robinson Crusoe," as presented at the Drury Lane theater, London, portable batteries are used for illuminating shells carried in the ballet, and for furnishing current for lights used in head decoration.

The city electrician of Omaha, Neb., reports that he is making a thorough inspection of electric light wires in buildings. He has found, it is said, a great deal of defective work, which rendered the buildings liable to destruction by fires.

A franchise has been given to Capt. Pabst to extend his electric lighting system into several portions of Milwaukee at present not included in the service. The new ordinance carries with it the right to extend the Pabst steam heating service over the same territory.

The municipal authorities at Falls City, Neb., are considering the matter of voting more bonds for the enlargement of the light plant. Upon enlarging, more boiler capacity, another engine and possibly a 1,000 or 1,200 incandescent light machine will be needed. The plant is operated under the direction of the water and light commissioner.

At the last meeting of the common council of Auburn, N. Y., the contract with the Auburn Electric Light company, which did most of the electric lighting in the city, was annulled. It is claimed that the company failed to comply with the provisions of the contract. The company will fight the resolution, and considerable litigation will probably ensue from the council's action.

Tacoma, Wash., is agitated over the action of the public authorities, who, it is claimed, have shown much favoritism in the matter of electric lighting, giving the Berlin Building company practically a monopoly to the exclusion of other companies desirous of furnishing light at a reduced price. Threats of wire cutting are made, and the situation is described by a local paper as "shocking."

Of the electric light service of Baltimore, Md., the general superintendent of the department of city lighting, says it is not as it should be. He thinks the contract with the Brush company "is too stringent for any company to live under," but no city officer has any right to modify it. The company is furnishing in the old city limits 1,031 arc lights, which cost last year $121,176.79, and in the annex four, which cost $481.70.

It is reported that a Berlin syndicate, which is said to have $15,000,000 to invest in American securities, has made an offer to the Minneapolis, Minn., city council to light the city for $60,000 a year less than is now being paid for the purpose. The agent of the syndicate is authority for the statement that it is already interested in lighting plants in several eastern cities. The people of Minneapolis, however, are known to be in favor of municipal ownership.

Fire completly destroyed the plant of the Attleboro, Mass., & North Attleboro Electric company, January 2d. The loss will probably exceed $70,000. The plant furnished power for the Interstate & Attleboro and North Attleboro & Wrentham Street Railway companies and electric light service of both Attleboros and Farmersville. The power service for the electric cars between Attleboro and North Attleboro, beside the two Pawtucket lines, is gone. The streets will be in darkness, and there is very little likelihood that the plant will be rebuilt for some time. An overturned lantern caused the fire.

Proceedings have been commenced for alleged infringement of patent by the Edison Electric company against F. P. Little & Co., of Buffalo, the firm which has the contract for installing an electric lighting system in the state hospital at Binghamton, N. Y. It is claimed that the infringement is based upon the Edison feeder and main system. The work on the Binghamton hospital has been in progress a month or more. It is reported from Binghamton that the work will not stop on account of the suit. Proceedings have also been begun against the Western Electric company of Chicago, which has the contract for lighting the Buffalo State Hospital.

The committee appointed by the city council of Cleveland, O., to investigate the electric lighting situation in that city, has reported that the charges now being made by the General Electric company are excessive, and suggested that the city could, at an expense of from $650,000 to $750,000, construct an electric lighting plant that would give an arc light at every street intersection and 15,000 incandescent electric lamps at 7 cents per thousand watt hours and pay such dividends that the plant would pay for itself in from fifteen to twenty years. Corporation Counsel Lawrence was requested to prepare a bill asking the authority of the legislature to issue bonds to the amount of $750,000 for an electric light plant, and an ordinance fixing the price of the light at 9 cents per thousand watt hours.

A most complete electric light installation has been decided on for a colliery in Lanarkshire, Scotland. The plant is to be divided into three parts. In the first the dynamo will run 300 lamps, in the colliery itself, to be distributed both throughout the pit and above ground. Another installation is devoted to the lighting of thirty-four workmen's cottages, which are about 700 yards from the colliery, there being three lights in each cottage, or a total of 102 lamps in all. The third installation consists of a complete electric pumping plant, capable of delivering 100 gallons of water a minute from the adjacent river to the colliery. The dynamos for the lighting of the pit and the workmen's cottages are being so constructed that either dynamo can be used for either purpose. Both machines are designed to give a constant pressure of current at the cottages under all variations of load.

ELECTRIC RAILWAYS.

Plans have been fully formulated for the construction of an electric railway in Geneva, N. Y. The Short company is under contract to furnish the necessary equipment. Work will be begun as soon as possible.

Plans are being prepared by the Reading Railroad company for the introduction of an automatic pneumatic electric system of signals and switches on its Philadelphia suburban lines, with a view to the absolute protection of its rapidly growing passenger business.

Two men attempted to hold up an electric car on the Eighth avenue line in Denver, Colo., on New Year's night. One of them smashed the headlight and made a dash for the motorman, who drew a revolver and fired at him. The motorman then turned on the current and both robbers were left behind.

A company is being formed at Babylon, Long Island, for the construction of a trolley road connecting Babylon with Brentwood and intervening places. A number of capitalists have signified their willingness to take stock in the corporation. The new road will probably be completed in a year.

Extensive improvements are being made upon the Grand View Beach electric railway near Rochester, N. Y. A car house is in process of construction, and as soon as completed it is expected that the power house will be erected near it. Providing this is done the company will probably make arrangements to light the village of Charlotte from this source.

It is stated that in the spring the Electric Light & Railroad company of Canandaigua, N. Y., will construct an electric road through Shortsville to Manchester, connecting that place with Canandaigua. The road will carry both passengers and freight, the power being supplied from the recently established plant at Littleville. The plant will also supply lights for Canandaigua and Palmyra.

A new railway enterprise to be known as the Toledo & Maumee Valley Railroad company is about to be incorporated with a capital stock of $300,000. The incorporators will be: William B. Taylor, Josiah D. Cook, George G. Metzger, Parks Foster and Grant Williams. The plan is to build an electric railway on a private right of way from Toledo to Maumee, on the north side of the river, cross the river at Maumee to Perrysburg, and run back on the south side to Toledo, where the Consolidated Street Railroad company's tracks will be used to secure termini, thus making a complete belt.

The contract for building the electric roads from Hartford, Conn., to New Britain, and also to Unionville, has been awarded, and construction of the two roads will be begun immediately. The new company which is to build the two lines is the Hartford & West Hartford Electric Railroad company. David Henney is president and W. E. Goodwin secretary. A combination of interests has been formed with the Hartford Light & Power company, by which that company will furnish the electric power. William H Goodrich will be secretary and treasurer of the power company. It is the intention to also acquire the charters of electric lines to Windsor and Windsor locks, and to Berlin and Middletown.

It is claimed that knowledge has been gained of a plot to cripple the lines of the Indianapolis electric railways, and it is also said that the names of former employes of the roads are associated with the charge. Threats to blow up the power house by dynamite, reports say, have been freely made. One of the men in the conspiracy has turned informant, and a number of insulators, which he says were fixed by the conspirators, have been given by him into the hands of the company. These insulators were shown to General Manager McLain. On the outside they are not distinguishable from other insulators in use, but they had been filled with metal so placed as to cause the current to leave the trolley wire and run down a pole to the ground. Had these false insulators been used it would have required much time to locate the trouble and the conspirators could have tied up the lines for a week or more.

The United electric railway of Nashville, Tenn., was placed in the hands of the Nashville Trust company and Thomas W. Wrenne as receivers January 5th. This action was taken for the best interests of the stockholders and bondholders. The receivers were appointed at Cincinnati by United States Circuit Judge Lurton. Mr. Wrenne is the president of the company. The United electric railway embraces sixteen lines, aggregating fifty miles of track. The net earnings for the first half of last year were $109,000, but owing to hard times business fell off, and the net earnings for the last six months only paid the October interest. Owing to the inability of some of th

stockholders and bondholders to meet assessments attempts at reorganization failed. The earnings of the company amount to nearly $1,000 per day, reaching in 1892 the sum of $342,000; in 1893 the earnings were $334,000.

TELEPHONE.

It is said that Honolulu was the first community in the world to make practical use of the telephone. Modern science advances very slowly in Honolulu generally, but when that community heard of the telephone it arose as one man and said: "Now, here is something worth talking about—and through." The people still eat raw fish and use their fingers for that purpose, but they use more telephones in proportion to population than New York does.

At a recent meeting of the United Service Institution of Great Britain a lecture was delivered on the telephotos, the idea of which is to actuate a number of incandescent lamps placed horizontally or vertically. It was explained that the theory of the telephotos was the production by incandescent lamps of the symbols of the Morse code, in dashes of 5 feet length made with ten lighted lamps, and dots of 3 feet made with one lighted lamp, and with unlighted intervals of 5 feet between each, which will bring under the eye the complete symbol at once,and is intended for use at any points within vision.

Herr von Hefner-Alteneck, president of the Elektrotechnische Verein, in his opening address, speaking of telephony, said: "I note first that the magneto telephones, up to a recent date used as transmitters on many German telegraph lines, have been replaced by microphone instruments. Another improvement is the replacement of battery call bells by magnetos in the telephone service of the Berlin exchanges. I should likewise mention the substitution of dry batteries for fluid cells in connection with microphones, and that such cells have given great satisfaction. As you know, the administration has been carrying on exhaustive experiments with compound or bimetallic conductors, and, as I understand, with highly satisfactory results."

MISCELLANEOUS.

On Friday, December 8th, Lord Kelvin unveiled in the vestibule of the Manchester, England, town hall, a statue of Joule. The movement was promoted by the Manchester Literary and Philosophical society, and a sum of £2,611 was raised for the purpose.

It is announced that the question of monopolizing by the state of all the Swiss water powers will be seriously proposed in the spring session of the Swiss Federal Council. The Federal Council commissioned A. Jegher to make an inspection of all the water forces in the country, and to draw up a report for use at the forthcoming discussion of the proposed law.

A dispatch from Portland, Ore., tells of a humorous incident in that place which was not without its serious side. Some break in the insulation of the wires connected with the incandescent lights at the bottom of the swimming bath at the Multnomal Athletic club created a wild commotion last month. Several persons who plunged into the bath were severely shocked by the escaping currents of electricity and were unable to help themselves. The friends who rushed to their assistance were smartly shocked by touching the brass railing around the tank, and in the general commotion the bathers came nearly being drowned before they were pulled out. The wire connected with the lamps was finally cut and an end put to the trouble.

The *Engineering Record* recently published a communication, in which it is proposed by Thomas Monroe, M. I. C. E., superintendent of the Soulanges canal in the province of Quebec, to operate lock gates electrically. Mr. Monroe writes that an electric motor transmits power through a train of gears to a pinion which works into a rack placed on the side of a 6 inch I beam. The end of this beam is attached to the top of a lock-gate, which it pushes shut or pulls open as may be required. The operation takes about 55 seconds and is performed with perfect ease. It is proposed to operate two pairs of gates and four filling and emptying sluices from one point in the center of the lock and upon whichever side may appear advisable. The experiments are not yet completed, and Mr. Monroe expects that the apparatus will be much simplified before being used on the canal.

TRADE NEWS.

Ziegler Bros., electrical engineers, Boston, Mass., are presenting to their friends and the trade a neatly engraved calendar for the new year.

The evening classes of the Correspondence School of Technology, Brainard block, Cleveland, O., in the branch of higher mathematics were commenced January 15th. G. T. Hanchett, S. B , is the instructor in this department. On January 18th the lectures on "Roofs and Bridges" were commenced by F. C. Osborn, C. E.

The Link-Belt Machinery company, Chicago, is supplying the western trade with fiber graphite bushings for hangers, pillow blocks, loose pulleys, etc. The company has issued a small hand-book describing this material and the advantage of its use which contains a number of interesting tables and some illustrations. The Link-Belt Engineering company, New York and Philadelphia, attends to this specialty in the eastern states.

The Interior Conduit & Insulation company, 44 Broad street, New York, has issued a particularly attractive catalogue descriptive of the Lundell motors and dynamos. The illustrations are of a high order of merit and show this type of apparatus in detail. Among other uses the Lundell dynamos are well adapted to marine work, and several interesting installations of this kind have been made. Full directions for unpacking and setting up machinery are given, and there are other features which make the book of interest and value.

The Metropolitan Electric company, Chicago, has added to its official staff J. J. Nate, for ten years purchasing and supply agent for the Chicago Telephone company. Mr. Nate's connection with the telephone business dates back to the summer of 1878. In view of the demand which will undoubtedly arise for experienced men in the work of handling the on-coming telephone business, the Metropolitan Electric company is to be congratulated in having secured the services of a man so well fitted by long experience and wide acquaintance as its manager.

The Brush Electric company has issued an interesting book descriptive of its exhibit at the World's Fair. The illustrations comprise various pictures of the exhibit itself, as well as the most modern types of Brush arc and incandescent electric lighting apparatus, switchboards, generators and motors. A glance at the book will suffice to show the extent of the representation of the Brush company, at the fair. The reading matter is taken from technical journals devoted to mechanical progress, which published extended descriptions of this company's apparatus, and the idea has culminated in a very presentable production.

To the Page Belting company must be given the credit of presenting to the trade the first authentic reproduction of the Columbian Exposition medals of award. The company received two of these medals, and it is sending out a folder with fac similes of the medals as well as a reproduction of the inscription on the diplomas obtained by this company. These points are mentioned in the judges' recommendation: Success in constructing leather belting of very great widths; superior quality of the belting on exhibition and in operation, especially its slotted belts; the magnitude and excellence of the display. The Page Belting company is always ready to make the most of a good advertising scheme.

BUSINESS.

The Hagen Accumulator company has acquired the sole right to manufacture the Waddell-Entz accumulators in Germany.

C. E. Lee, manager of the Abatis Electric Manufacturing company, Chicago, is receiving orders from Australia as well as other foreign countries, for its well known fire alarm apparatus.

Among the many unique articles sent out with the compliments of the holiday season by the electrical fraternity is one from the Electric Railway Equipment company of Cincinnati, O. It is a paper weight made of bronze, and represents an electric car complete in all details.

George G. Carter & Co. announce that they have secured the order for all of the wires and cables for the Champlain building, Chicago. The Habirshaw insulation, especially prepared for plaster work, will be used exclusively. The firm also reports the sale of 5,000 lamps and that it is well pleased with the auspicious commencement of its business.

The Electric Appliance company, Chicago, reports considerable progress with the Packard transformer. Two orders of nearly one thousand lights capacity each is the record for the last week, in addition to numercus smaller orders in the last few weeks aggregating over one thousand lights. The company refers to reports from customers, which show a high efficiency, coupled with close regulation and general satisfactory results.

The Metropolitan Electric company, Chicago, reports having large sales of its new "Metropolitan" lamp, and that practical men are finding it to be thoroughly serviceable. The company is moving into its new building, 186 and 188 Fifth avenue, Chicago, where it will have ample store and office facilities, besides warerooms. A large line of staple goods is being put in to enable the company to take care of all orders without delay.

ELECTRICAL PATENTS.

Issued January 2, 1894.

511,758. Electric Motor. Walter A. Crowdus, Chicago, Ill.

511,763. Trolley. William F. Duncker, Steelton, Pa.

511,787. Self-closing Telegraph Key. Henry E. Moss, Kansas City, Mo.

511,791. Ammeter and Voltmeter. J. Perry and C. E. Holland, London, Eng.

511,821. Storage Battery System of Distribution. Jakob Trumpy, Hagen, Germany.

511,822. Storage Battery System of Distribution. Jakob Trumpy, Hagen, Germany.

511,824. Trolley Mechanism for Electrically Propelled Vehicles. C. H. Veeder, Lynn, Mass.

511,853. Trolley Wire Support. Charles T. Lee, Boston, Mass.

511,862. Electric Locomotive for Elevated Tracks. Charles H. Roberts, Hartwell, O.

511,866. Electric Alarm for Cane Feeders. August F. Slangerup, New Orleans, La.

511,873 Electric Circuit Controller. Romaine Callender, Brantford, Ont.

511,874. Telephone Exchange System. Romaine Callender, Brantford, Ont.

511,875. Telephone Exchange System. Romaine Callender, Brantford, Ont.

511,882. Telephone Transmitter. Stephen C. Drew, Boston, Mass.

The transmitter is a combined magneto and variable contact transmitter. The diaphragm vibrates before the pole of a permanent magnet, thus causing the length of the magnet to vary in response to the varying strength thus produced. The end of the magnet rests against a carbon block, the block and magnet being included in a local circuit. The variable pressure of the magnet upon the carbon produces undulations in the current of the local circuit, which, passing through the induction coil, generate undulatory currents upon the line that pass the receiving station.

511,883. Registering Apparatus for Telephones. Angelo R. Duperu, San Francisco, Cal.

511,889. Electric Switch. Jesse L. Hinds, Syracuse, N. Y.

511,915. Electrical Transmission of Power. Nikola Tesla, New York, N. Y.

The invention relates to the operation of rotary field motors and consists in sending multiphase currents through the coils of one of the members, say the stationary member, and thus inducing currents in the movable member currents, which produce magnetic fields, which react upon the field produced by the former coils to effect the rotation of the movable member.

511,916. Electric Generator. Nikola Tesla, New York, N. Y.

The generator is of the electric oscillator type and comprises a piston adapted to be reciprocated by fluid pressure against the tension of a spring, thus causing isochronous vibrations, which produce in a coil of wire placed in a magnetic field vibratory isochronous electric currents.

511,928. Section Insulator. H. M. Brockbank, Brooklyn, N. Y.

511,941. Trolley Catcher. G. E. Gay and J. H. Parsons, Augusta, Me.

511,946. Electric Clock. Fred L. Gregory, Niagara Falls, N. Y.

511,953. Push Button. Charles D. Hunking, New York, N. Y.

511,988. Electric Locomotive. Edward M. Bently, Boston, Mass.

512,027. Regulator for Continuous Current Arc Light Circuits. Daniel Higham, Boston, Mass.

The regulation is accomplished by producing in a branch circuit by the action of the current in the main circuit current waves differing in phase from current waves in the main or working circuit, and controlling the current in the main circuit from the variations in the branch.

512,050. Electrically Controlled Railway Signal. Frank McBrien, Newark, N. J.

512,051. Electrically Controlled Railway Signal. Frank McBrien, Newark, N. J.

512,055. Cartridge Shell Battery. James J. Pearson, Brooklyn, N. Y.

512,077. Electrically Controlled Railway Signal. James Wayland, Newark, N J.

512,102 Transmission of Rapidly Alternating Electric Currents. Wm. H. Eckert, New York, N. Y.

The transmission is effected by means of bimetallic conductors, such as steel and copper in equal parts, and is based upon the discovery (as stated by the inventor) that rapidly alternating currents may be more perfectly transmitted upon such a bimetallic conductor than upon a conductor of one material, such as copper; and further, that transmission may be effected upon a circuit consisting of a single composite wire and an earth return as perfectly as though two copper wires, each of equal conductivity, were arranged in a closed metallic circuit.

512,115. Electric Current Regulator. Ansel B. Jones Cleveland, O.

512,146. Wire Covering Machine. Walter H. Avis, Toronto, Ont.

512,201. Overhead Trolley Wire Switch. G. W. MacKenzie, M. B. Sloan and T. C. Sloane, Beaver, Pa.

512,214. Composite Telephonic and Multiple Telegraphic Transmission. Frank A. Pickernell, Newark, N. J.

512,217. Electric Call. Purdy M. Randall, Concord, N. H.

512,227. Regulator for Dynamo—Electric Machines. Charles E. Scribner, Chicago, Ill.

The regulator operates to maintain the current strength in the working circuit constant by changing coils of the field magnets from a shunt to a series relation with the working circuit, and *vice versa*, thus altering the field strength and consequently the strength of the current.

512,250. Electric Indicator. Adrian H. White, Manchester, N. H.

The indicator is, as usual, provided with an index finger adapted to be moved over a scale in response to the magnetic effect of the electric current, and in order to render the instrument dead beat a frictional block bears upon the axle upon which the index is mounted, and frictionally acts to bring the index to rest at the proper point without permitting the momentary passage of such point due to the inertia of the moving parts.

512,253. Secondary Battery. William C. Lockwood, New York, N. Y.

The electrodes of the battery are constructed by depositing metallic tin in a spongy or flocculent state from a solution of chloride of sodium and chloride of tin by electrolytic action.

11,397. Electrical Connection. Hercules Sanche, Detroit, Mich.

11,398. Electrical Connection. Hercules Sanche, Detroit, Mich.

Western Electrician.

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Lighting Plant in a Large Chicago Store.

In a city famed for the number of its fine office buildings and large retail establishments it is not strange that Chicago should also boast a proportionately large number of the most modern and complete isolated electric lighting plants. One of the most recently installed of these, and one which is interesting from the fact that an extraordinary amount of service will be required of it, is that which is furnishing light for the retail store of Marshall Field & Co., comprising the old building on State street and the new building on the corner of Wabash avenue and Washington street. From the nature of the business almost constant light is required throughout the day, and it is estimated that in this time of the year an average daily demand of 60,000 lamp hours is exacted. It is a matter of doubt if there is another isolated plant in Chicago which is obliged to run a higher average daily load than this, although of course there are several instances where more lamps are run for a time than in this one. The plant is located in the building directly north of the new store and is on the ground floor. An independent steel and brick arched floor with 15-inch I beams, and 23 foot spans forms a substantial foundation for four big Edison dynamos and two Western Electric arc light machines, and also serves as a roofing over the boiler plant. The Edison dynamos are of the upright bi-polar type, compound wound for 140 volts, and are of 100 kilowatts capacity each, belted to 70-inch pulleys on a line of shafting driven by belting running through the floor to the engine room underneath the dynamo room, where are located two single cylinder, 22 by 33-inch, simple condensing, Buckeye Tangye engines of 325 horse power each. Two Western Electric low-tension arc machines, giving 18 amperes and having a capacity of 50 2,000 candle power lamp, each, are driven in the same manner on 74-inch pulleys. The six dynamos are similarly arranged into two batteries of three machines, a view of one of which is presented upon this page. The incandescent dynamos make 650 revolutions a minute, while the Western Electric arc lighters run at about 1,250. The grouping of the dynamos has been carefully planned, the floor space being 70 feet in length, but only 24 feet wide. The lights furnished by this plant are scattered throughout both stores and the offices in the new building. Over 5,500 incandescent lights are used and about 100 arc lamps. Fifty of the latter are made of an exclusive ornamental pattern, especially designed for Marshall Field & Co. by the Western Electric company. They use a 5/8 inch upper carbon and a 1/2 inch lower carbon, and are particularly graceful and pleasing. The 500 lights in the show windows, at present attached to the Edison central station service, are to be furnished with current by another isolated plant, now in process of installation, in the basement of the building. It comprises an Edison 40 kilowatt dynamo wound for 110 volts, belted to a simple Buckeye engine, 14 by 24 inches, of 75 horse power capacity, and a 25 horse power engine, 8 by 12 inches, of the same manufacture, driving a Western Electric 20 kilowatt generator, which runs eight motors, ranging from 3 to 6 horse power, used in different portions of the establishment for ventilating, running sewing machines, and power purposes generally.

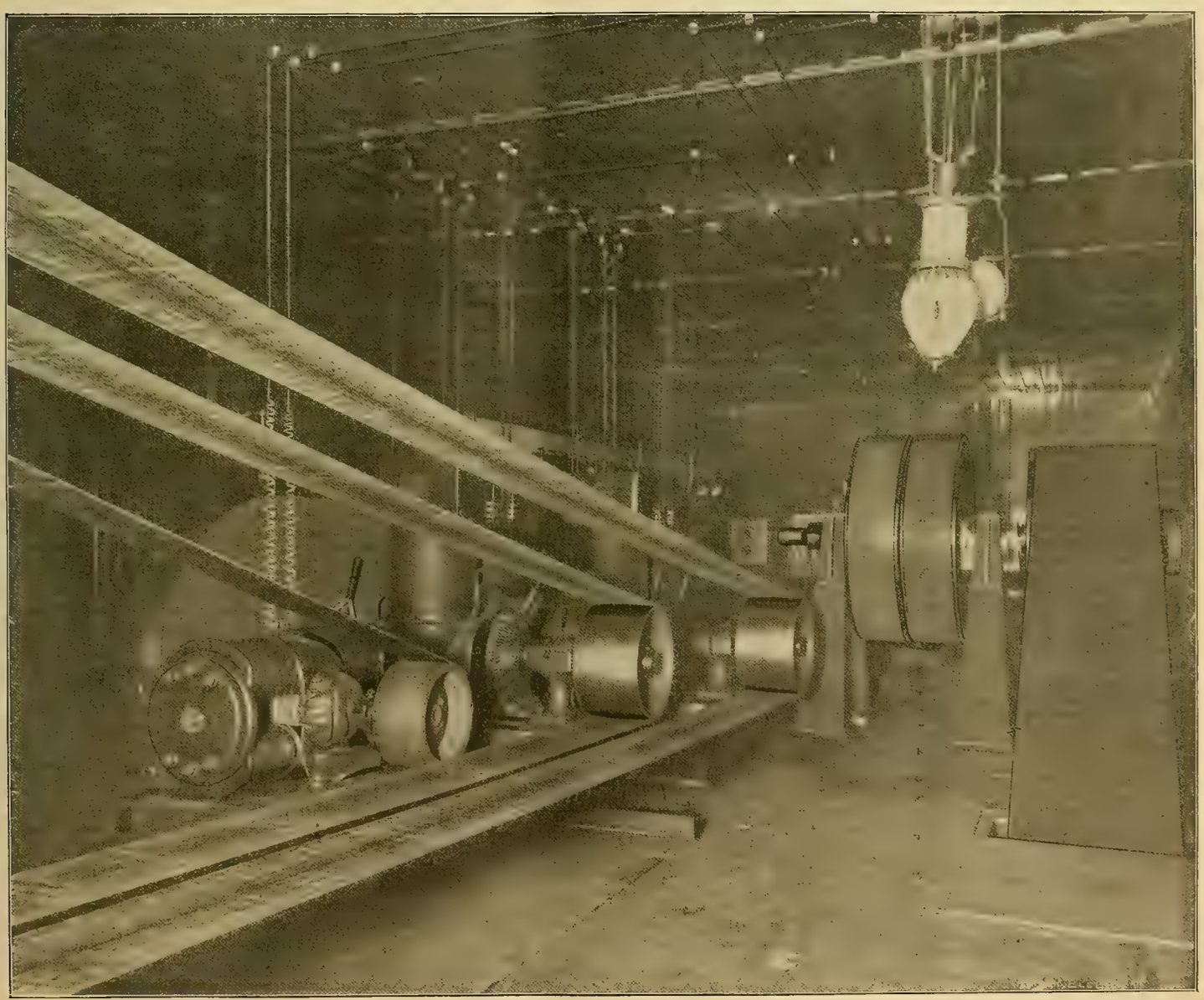


FIG. 1. LIGHTING PLANT IN A LARGE CHICAGO STORE.—VIEW OF DYNAMO ROOM.

One of the most attractive features of this plant is the switchboard, which is shown in Fig. 2. It is constructed of eight slabs of white Italian marble, making a board 24 feet long and 8 feet high. It is trimmed with polished copper tubing and, as seen in the picture, is ornamented with several combination gas and incandescent light fixtures which hang down and project over the board.

On the board are four rheostats, four Edison dynamo

ammeters of 1,000 amperes capacity each, a Weston am meter reading to 3,000 for indicating the total output of the plant, 16 circuit ammeters of 400 amperes capacity each and 20 single-pole knife switches. Siemens C. L. A. leaded and asphalted cables, ranging from 300,000 to 700,000 circular mils, pass from the back of the board through a subway 310 feet in length to the old building. On a small marble board at the end of the larger board is a Weston voltmeter and a Weston galvanometer, which act very much on the principle of a synchronizer and is intended to indicate the regulation of the machines. The main bus bars, made of copper, 2½ by ¼ inches, are on the front of the board below the single pole switches, while all the connections are made on the back of the board. It will be noticed by reference to Fig. 1 that heavy copper conductors, 1¼ by ⅜ inches, held in place and fastened to the ceiling by polished brass cleats fixed upon slate bases, run from the Edison dynamos to the board. Equalizer bars, meeting at a common point upon the ceiling, are used upon these machines. All feeder wires were made by the Edison Machine Works and the cables on the tap lines are of Okonite insulation. The cut-out cabinets throughout the building are fire-proof and have a 1,000 light capacity on each floor. Although that portion of Marshall Field & Co.'s establishment which is supplied with light from this plant

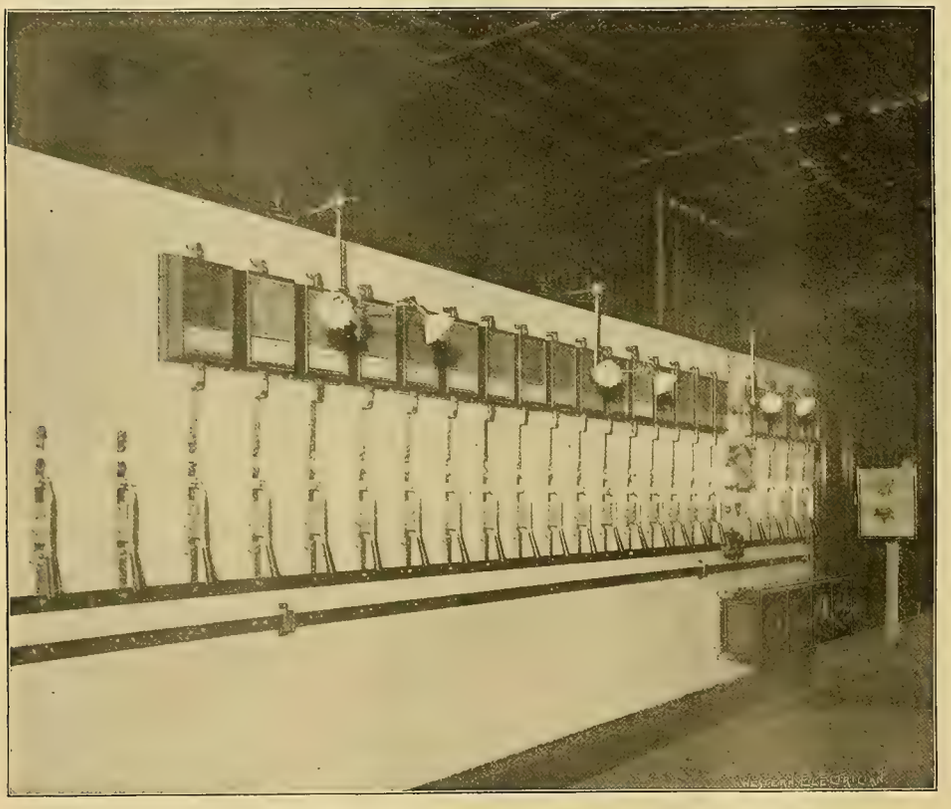


FIG. 2. LIGHTING PLANT IN A LARGE CHICAGO STORE.—VIEW OF SWITCH BOARD.

is wired upon the two-wire system, that section of the new building which is devoted to private offices is wired upon the three-wire convertible system, and is connected with the Edison service. The Western Electric company has also installed a plug contact switchboard in the dynamo room opposite the main switchboard, to be used in connection with its arc light machines.

In Fig. 3 is presented a view of the boilers, of special design, used for supplying steam for running the elevators, engines and pumps, and for heating the buildings. Here is, perhaps, the only large installation of its kind in Chicago. Owing to a lack of available room the marine type of boilers was chosen, and ten tubular boilers, 14 feet by 74 inches, of 100 horse power capacity each,were placed in position. Coal was used for combustion for a long time, but about three months ago this fuel was discarded and natural gas substituted. The gas is piped from Indiana and is distributed to the series of 50 to 80 or 90 Bunsen burners in the fireboxes of each boiler from 5-inch pipes, shown in the illustration in front of the boilers, allowing of perfect distribution and exact control. The boilers are provided with a lever and ratchet device for opening and regulating the draught doors, as shown. In the fire boxes is a horizontal water table designed to minimize the production of smoke before it passes into the breeching leading to the stack, but natural gas has eliminated smoke as well as ashes, and done away with stokers, firemen, and many other annoyances and expenditures attendant upon the use of coal. In this room are also to be found three 10 by 7 by 10 inch Worthington admiralty duplex pumps, with a capacity of about 15,000 gallons an hour each for forcing water into the heaters and thence into the boilers. Two 12-inch pipes carry the steam frem the boilers for distribution.

Altogether, the installation is of considerable interest, and has taken its place among the notable isolated electric lighting plants in Chicago.

World's Fair Changes.

That the electrical affairs of the World's Columbian Exposition are about wound up is shown by the fact that the resignation of Richard H. Pierce, the electrical engineer, has been accepted, taking effect on January 20th. Mr. Pierce was appointed assistant electrical engineer on November 23, 1891, and since that time he has given the World's Fair his best thought and energy almost night and day. Early in March, 1893, he assumed full charge of the electrical engineering department, and has since verified the prediction made in the WESTERN ELECTRICIAN at the time, that he was 'sure to make a good record in his new position." Of unquestioned technical ability, skillful in mechanical contrivance, possessing an unusual personal popularity due to the assured conviction of his associates that "Dick" Pierce was perfectly "square," and fortunate in having a temperament that enabled him to present an unruffled front in face of the constantly recurring perplexities of his position, Mr. Pierce has indeed made a fine record. With Mr. Neiler, the assistant electrical engineer, he is now engaged in finishing his report, and he has opened a temporary down-town office at 501 Manhattan building.

Another interesting announcement is to the effect that E. E. Keller, the general superintendent of the Westinghouse interests at the World's Fair, has left for the East and that he will locate in Pittsburg on February 1st. Mr. Keller has been elected vice-president and general manager of the Westinghouse Machine company, and will hereafter devote himself to the interests of that concern, which will give especial attention to the manufacture and sale of engine-dynamos of the Westinghouse type. A brief reference to the extent and excellence of the work accomplished at Jackson Park under Mr. Keller's direction was made in a recent issue of this journal.

American Institute of Electrical Engineers.

At the meeting of the council of the American Institute of Electrical Engineers on January 17th the following associate members were elected:

Comfort A. Adams, Jr., Cambridge Mass.; U. N. Bethell, New York; Francis Broadnax, New York; Joseph Broich, Brooklyn, N.Y.; Sigfried H. Ende, New York; Thomas Francis Flanagan, Portsmouth, N. H.; Bertram P. Flint, New York; James Mason Knox, New York; Wynn Meredith, San Francisco, Cal.; Max Osterberg, New York; R. L. Selden, Jr., Deep River, Conn.; George F. Sever, New York; Charles Henry Smith, Atlanta, Ga.; Sidney Sprout, San Francisco, Cal.; George A. Wardlaw, Oswego, N. Y.

The following associate members were transferred to full membership:

W. L. R. Emmet, New York; Nathaniel S. Keith, San Francisco, Cal.; Alton D. Adams, Worcester, Mass.; C. E. McCluer, Richmond, Va.; J. P. Jackson, State College, Pa.

Northwestern Electrical Association.

The second annual meeting of the Northwestern Electrical Association was held at Milwaukee, Wis., last week. Carroll Collins, president of the organization, called the meeting to order at the club room of the Pfister hotel on Wednesday afternoon, January 17th. The following named members and visitors were present during the convention:

MEMBERS AND GUESTS.

H. Armindson.....La Crosse, Wis.
Herman Andrae.....Milwaukee, Wis.
Julius Andrae.....Milwaukee, Wis.
J. A. Andrews.....Hudson, Wis.
W. B. Baker.....Waupaca, Wis.
W. D. Ball.....Chicago, Ill.
A. J. Benwitz.....Racine, Wis.
J. A. Berkey.....Little Falls, Minn.
F. N. Boyer.....Chicago, Ill.
A. C. Bunce.....Chicago, Ill.
M. A. Burt.....Baraboo, Wis.
G. L. Cole.....Beloit, Wis.
S. G Coleman.....Milwaukee, Wis.
W. Forman Collins.....Chicago, Ill.
Carroll Collins.....Green Bay, Wis.
G. A. Davis.....Appleton, Wis.
E. L. Debell.....Sheboygan, Wis.
Fred DeLand.....Chicago, Ill.
J. Earl.....Kaukauna, Wis.
E. Engebretson.....Whitewater, Wis.
G. A. Farwell.....Waukesha, Wis.
W. J. Ferris.....Chicago, Ill.
L. V. Gibbs.....Milwaukee, Wis.
W. Goltz.....Milwaukee, Wis.
H. D. Goodwin.....Milwaukee, Wis.
Thos. G. Grier.....Chicago, Ill.
T. F. Grover.....Wawautosa, Wis.
Geo. Grimm.....Jefferson, Wis.
Prof. D. C. Jackson.....Madison, Wis.
M. H. Johnson.....Milwaukee, Wis.
C. D. Johnson.....Tomah, Wis.
Oscar D. Kleinsteuber.....Milwaukee, Wis.
P H. Korst.....Racine, Wis.
R. F. Kountz.....Milwaukee, Wis.
H. D. Latimer.....Chicago, Ill.
I. P. Lord.....Waupaca, Wis.
W. W. Low.....Chicago, Ill.
C. S. Lykom.....Antigo, Wis.
Geo. Mayo.....Chicago, Ill.
P. J. McFadden.....Chicago, Ill.
Frank McMaster.....Chicago, Ill.
G. F. Merrill.....Ashland, Wis.
S. F. B. Morse.....Chicago, Ill.
James Motley.....Milwaukee, Wis.
M. Nippert.....Lake Geneva, Wis.
Pliny Norcross.....Janesville, Wis.
F. Overbagh.....Chicago, Ill.
C. C. Paige.....Oshkosh, Wis.
T. A. Pamperin.....Oconto, Wis.
E. K. Patton.....Boston, Mass.
P. H. Polglase.....Chicago, Ill.
O. M. Rau.....Milwaukee, Wis.
W. B. Shaw.....Chicago, Ill.
John Shutte.....Manitowoc, Wis.
J. G. M. Smith.....Chicago, Ill.
C. A. Spencer.....Centralia, Ill.
M. L. Stevenson.....Cleveland, O.
W. N. Stewart.....Chicago, Ill.
D. S. Terry.....Chicago, Ill,
H. C. Thom.....Madison, Wis.
W. H. Thorp.....Beaver Dam, Wis.
J. H. Trever.....Antigo, Wis.
W. C. Wheaton.....Chicago, Ill.
G. S. Whyte.....Chicago, Ill.
John Wiley.....Hancock, Wis.
I. C. Woodward.....St. Paul, Minn.

The address of welcome was given by Mayor Koch of Milwaukee, who cordially welcomed the delegates and extended to them the freedom of the city. Ex-Senator Merrill of Ashland responded to the address of welcome in behalf of the association. On motion of Ex-Senator Merrill Mayor Koch was made an honorary member of the association. After the routine business had been transacted and a number of new members elected, W. N. Stewart read a paper on "Advantages of Directly connected direct current generatoss." The paper brought out a good discussion, which was participated in by a number of the members.

At the evening session the election of officers for the ensuing year was held and resulted as follows:

President—C. C. Paige, Oshkosh, Wis.
First vice-president—W. B. Baker, Waupaca, Wis.
Second vice-president—E. L. Debell, Sheboygan, Wis.
Secretary—H. C. Thorn, Madison.
Treasurer—G. F. Merrill, Ashland.
Directors—W. Goltz, Milwaukee; Pliny Norcross, Janesville; John Shutte, Manitowoc.

The following committees were appointed:

Committee on legislation—H. C. Thom, George F. Merrill, George Grimm.

Committee on transportation—I. P. Lord, Pliny Norcross, O. M. Rau.

Committee on entertainment—J. C. Woodward, W. B. Baker, L. E. Debell.

Committee on special legislation for underwriters' rules—H. C. Thom, Pliny Norcross, J. A. Andrews.

Committee for preparing rate schedule—George A. Davis, George Farwell and P. H. Korst.

Discussion on next place of meeting was then taken up, St. Paul being the favorite. A paper was then read by Prof. D. C. Jackson of Madison, on "Essential Station Instruments" and was followed by a lively discussion. The convention then adjourned till 9:30 Thursday morning.

When the session was resumed on Thursday morning, St. Paul was decided upon as the next meeting place, the convention to take place in July.

W. W. Low of Chicago read a paper on "New Things in Electricity," and discussion on it then took place.

Two papers on "Economical Use of Transformers" were then read, the first by W. Forman Collins of Chicago and the second by P. J. McFadden of Chicago. The remainder of the morning session was taken up in discussing these papers.

The afternoon session was called to order at 2 P. M., and E. L. Debell of Sheboygan presented a paper on 'Corliss Compound Engines." After discussion on this subject H. O. Thom of Madison read a paper on the "Trend of Electric Investment" instead of the subject allotted to him, "How Shall Members Buy Supplies?" This paper evoked considerable discussion of the subject of rates for service. This concluded the business session and the convention then adjourned to attend the banquet in the evening. The next day was devoted to visiting various plants in the city and other points of interest.

Convention Notes and Personal.

Thos. G. Grier, of the Bryant Electric company, was around with a pocketful of sockets and switches. His principal occupation was in leaving hotel calls for his friends, much to their discomfiture and his delectation. The drowsy occupant had only to press the button; Grier did the rest.

S. F. B. Morse, of Cushing & Morse, Chicago, was on hand booking orders for Kerite, and seeing that everyone was provided for.

The General Electric Fixture company was represented by F. Overbagh, who discoursed on the beautiful and fantastic forms of his new electroliers with the skill of an artist.

The Electric Appliance company showed the Packard mogul incandescent lamp, for which it is general western agents, and also the new Packard transformer and the Washington arc lamps for alternating incandescent circuits. W. W. Low, president of the company, was on hand, and it therefore goes without saying that everyone heard all about its specialties. He was ably assisted by Frank McMaster.

The Fort Wayne company showed some photographs of their latest arc lighters and alternators. I. C. Woodward, of St. Paul was in charge, explaining the company's apparatus and inviting everyone to sample the famous new "Wood" brand of cigars.

The General Electric company made an exhibit of lamps and some other specialties in the supply line, their interests being well taken care of by A. C. Bunce, F. N. Boyer, W. J. Ferris, P. J. McFadden, W. C. Wheaton and S. G. Coleman.

The brothers Andrae were on hand in nowise discouraged by their recent burn out, and ready to do more business than ever before.

The Central Electric company's interests were looked after by H. D. Latimer, who acquired distinction by the way in which he boomed Okonite and the many specialties handled by this widely-known concern.

Lucius T. Gibbs, of the Gibbs Electric company, of Milwaukee, was in attendance, promoting at all times the entertainment of the visitors.

The banquet was held on Thursday evening at eight o'clock at the Hotel Pfister, and was largely attended by the members and delegates and a number of Milwaukee's prominent citizens. H. C. Thom acted as toastmaster and his pleasantries in this capacity were both brilliant and amusing. Responses to the various toasts were given by Messrs. Merrill, Mercein, Stewart, Underwood and Flanders. A song by George Whyte was among the entertaining features of the evening. Cushing & Morse, through S. F. B. Morse, provided the wine for the banquet, and the General Electric company, through A. C. Bunce, the cigars, and the A. W. Harris Oil company, through D. S. Terry, bouquets for all present. A floral center piece, composed of artificial and natural roses illuminated by miniature incandescent lamps and designed by the General Electric company, was a unique and attractive feature of the decorations. About seventy-five persons were present and a thoroughly enjoyable evening was spent.

It is said that the Dravosburg Electric Street Railway company will build immediately four and one-half miles of railway. The company is capitalized at $27,000. This line, it is asserted, will connect with the Second avenue, Pittsburg, line at Homestead, making a continuous electric line from McKeesport to Pittsburg. The latter road will cross the river by a bridge to be built by the Glenwood Highway Bridge company at or near Glenwood, in order to get into Homestead.

Advantages of Directly Connected Direct Current Generators.[1]

By W. N. Stewart.

Members of this association who were present at the last convention at Madison undoubtedly remember that the speaker was somewhat pronounced in his advocacy of direct current apparatus for central station lighting in towns such as exist most commonly in the northwest; for this reason he probably owes the request from our worthy secretary to prepare a paper to be read at this meeting on the advantages of direct connected directly current apparatus.

While I hope to present strong reasons for the faith that is in me, it should not be understood that the alternating systems are to be condemned in all cases. For transmission of light or power to long distances, some form of alternating or multiphase current apparatus may be employed to advantage. The same is true when lights are scattered over extended areas. What I propose to speak of to-day will solely refer to electrical work over areas not to exceed three miles in any direction from the power house, under the average conditions of the average northwestern city of not to exceed 35,000 inhabitants; where streets are to be lighted with arc lamps, and stores and residences with either arc or incandescent lamps, as preferred, motive power being furnished where a demand for the same exists; current to be furnished twenty-four hours daily to all customers.

Permit me to describe what I should consider a model plant of 500 horse power, the sizes of machinery, etc., being proportionately increased or decreased for a larger or smaller installation. I shall describe electrical details only, as local conditions govern the class of power plant, only presuming that steam power is used. For water power the arrangements would be the same, except that in most cases one belt would be necessary for each generator.

For the generating plant the following apparatus would be installed: One multipolar generator of 100 horse power, running at about 250 revolutions per minute, directly connected to a compound engine of the same speed. One multipolar generator of 400 horse power, running at about 170 revolutions per minute, directly connected to a compound engine of the same speed. In most cases condensing apparatus is to be used where water is available. These dynamos are to be made for 220 volts if the three-wire system is used, and for 480 volts if five-wire system is employed; three-wire distribution to be employed where the distances are not over one mile from the power house, and five-wire where they exceed one mile. Additional apparatus as follows would be necessary: For three-wire system, 120 cells of storage battery, each cell having a capacity of 30 amperes for fifteen hours; for five-wire system, 240 cells of battery, same size. This storage plant to be used as an equalizer and regulator, and to furnish current during the day. Necessary switchboard apparatus, including an automatic regulator for dynamos, would also be necessary.

The wiring would be as follows: One circuit of mains and feeders for commercial and house lighting. This would supply all private consumers with arc or incandescent lighting or motive power; each customer to have a meter; all motors to be connected to the outside wires of either three or five wire system.

To operate this plant, we would employ but two men, one engineer and one fireman. The station should have a superintendent, and lamp trimmers as necessary for the number of arc lamps used.

The public arc lamps would be wired as follows: If three-wire system is used, a common neutral wire would be supplied for both public and private lights; this neutral being thoroughly grounded at various points. Thus but two wires would be run for the public lighting, the arc lamps being connected in groups of two between the positive and neutral. If the five-wire system is used, the arc lamps would be run in groups of eight, each lamp having an automatic cut-out. To run arc lamps on a constant potential circuit, it it necessary to have a certain amount of resistance in the circuit to steady the arc; this resistance should be in the line wire, iron wire being used in some cases, or copper wire not smaller than No. 8.

But my technical friends will immediately say: "This resistance is a waste of power and therefore to be avoided." True, according to the usual theories. It is but a few years ago that the English electricians denied Mr. Edison's statement that he had attained the practical subdivision of the electric light; and the pathway of electrical development is strewn with the wrecks of exploded theories. Let us see if this loss in resistance is not a pebble over which electricians have stumbled, thinking it a mountain.

In the last edition of Prof. Silvanus Thompson's "Dynamo-electric Machinery," a standard authority, he gives the efficiency of the best arc dynamo of the constant current type at 78 per cent. A few pages further on he mentions constant potential dynamos having an efficiency of 95 per cent. or more. His arc machine will not maintain its initial efficiency for any length of time, as its insulation constantly carbonizes and runs down. Here, then, we have something very practical to start on. If the ordinary arc dynamo gives 78 per cent. efficiency and the constant potential machine 95 per cent., we have a difference of 17 per cent. in favor of the constant potential machine. The resistance necessary to work the low tension arc lamps never exceeds 15 per cent. of the current, so that we have an advantage of 2 per cent. in favor of the system which I am describing.

But we have still another gain: The ordinary arc dynamo runs at about 900 revolutions per minute, and must therefore be belted to the engine. The friction of this belting and high-speed dynamo must be taken into consideration. If one belt direct from engine is used, 10 per cent. is lost; if a counter-shaft is used, 18 per cent. is lost. So that in one case we gain 12 per cent. in our power bill, and in the other 20 per cent. And this is not theory. It is being done every day in the State of Wisconsin and adjoining states.

It may be said here, in passing, that the arc lamps used on this system can be had of any candle power from 600 to 12,000, so that the light can be distributed through a city in any desired manner; that these lamps burn as steadily as any incandescent lamp; that they are closed to prevent the entrance of dust, snow or insects, and throw but little shadow underneath.

The operation of such a station would be as follows: The small dynamo would be started not later than four o'clock in the afternoon, most of its current being absorbed by the storage battery. As darkness approaches, the large dynamo would be started, its current being divided be-

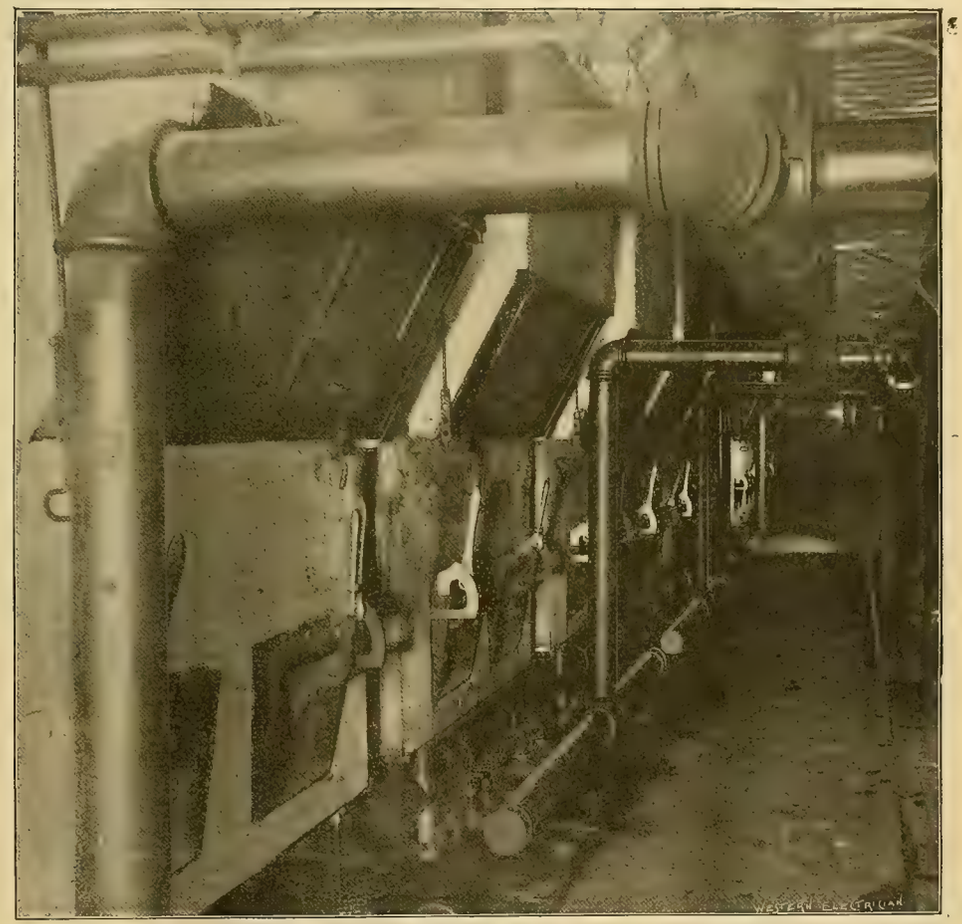


FIG. 3. LIGHTING PLANT IN A LARGE CHICAGO STORE.—VIEW OF BOILER ROOM.

1. Read before the Northwestern Electrical Association, Milwaukee, Wis., January 17, 1894.

tween the customers, streets and storage battery, until all the lights are burning, when the battery would simply act as a regulator. This engine would run steadily until two o'clock in the morning, the last four hours being principally devoted to charging the battery.

Thus the employes would have a daily run of 10 hours, and the engines would always work at maximum efficiency for the full run. The battery would do the work 14 hours daily. It may be well to state here that storage batteries are now being used in most European stations and in three or four of the largest American stations with good results, and that batteries can be had which infringe no patents and which are thoroughly reliable in their action.

We then have a station which is made up as follows: One machine in operation at one time, doing all our work, that machine having an efficiency of 95 per cent. with no losses in belting or shafting, running at slow speed with consequent minimum of cost for repairs; a daily run of only 10 hours, thus getting the best possible service from employes; current available day and night for all pur-

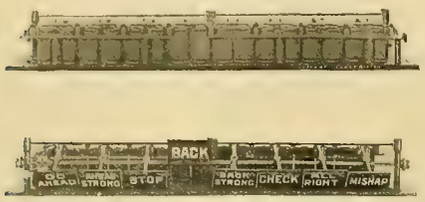


FIG. 2. A NEW AND SIMPLE SIGNALING DEVICE.

poses; a machine which does not burn out and which can be repaired in three hours; low pressure wiring, therefore no damage suits for loss of life; longer life and less blackening of incandescent lamps, as the battery gives a current absolutely uniform at all times; less real estate and buildings required; less liability to breakdowns; no burned-out armatures; the average cost of burned-out armatures on arc machines in 77 cities was, last year, $2.14 per arc lamp; less oil; fewer employes; no losses in transformers or other subsidary apparatus.

What is the economy? It might startle you to say it would be 40 per cent. per annum over old-fashioned methods, but this is being done every day. The committee on directly connected generators of the American Street Railway association reported at the convention recently held in this city that any electric railway could afford to throw its machinery into the scrap heap, increase the interest account 15 per cent., and yet be 25 per cent. per annum the gainer. The results are even more favorable in lighting when a storage battery is used.

The chief electrical engineer of the World's Fair reported in favor of direct-connected generators, and one machine for arc and incandescent lights and power. All through the country the largest concerns are throwing out the high speed belted apparatus, and not for reasons of mere sentiment, but because it pays.

It pays because the modern slow speed multipolar generator is as near perfection as can ever be attained, and because its high initial efficiency is maintained for many years. This is not true with the older type of high speed machines, on account of the too liberal use of carbonizable insulation and lack of radiating surface. The multipolar dynamo as now made has an armature winding of solid copper bars, largely exposed directly to the air and of minimum internal resistance. Mica is largely used for insulation, and only about 2 per cent. of the total current is used to excite the fields. Recent investigations have shown the annual wear and tear of belting to be 37 per cent. of the first cost, and the annual number of interruptions to service from its use to be five. In the Chicago Auditorium, official figures show an annual economy of $46,500 on a plant of 17,000 incandescent lights in favor of direct connected machines. Equally favorable results are reported from many other places. Incandescent lights are being furnished in the city of Chicago to-day for less then one-half cent per hour, and good profits realized. In the city of New York the arc light companies charge 40 cents per night for one lamp of 2,000 candles. The Edison company furnishes two lamps of 1 200 candles each for 50 cents per night from a low-pressure circuit, although cost of carbons, trimming and interest on investment is much greater. Arc lamps of 1,200 candles burning all night every night in the year are being furnished in the state of Wisconsin for $50 per year from low pressure circuits and with profit to the owners of the plant.

In this connection it should be remembered that if a large upper cored carbon and a small lower solid carbon are used that 50 per cent. more light is obtained (according to Prof. Carhart, of Michigan University) than with the ordinary carbons. Thus a six ampere lamp is practically as good as a nine ampere lamp; these carbons cost more, but the fuel consumption is less, and the net result is a large saving.

Can the existing stations be rebuilt without too great sacrifice? In most cases, yes. Engines, boilers and power plant can be utilized usually; poles need not be changed; wire can all be used; old dynamos and arc lamps can be sold for 25 per cent. of first cost. Therefore no reason exists why any manager should persist in using obsolete methods.

In conclusion, I thank you for your kindness in giving me so attentive a hearing, and I assure you that I have carefully tried to confine myself to facts as observed by me in this country and Europe; to reiterate my belief, founded on 23 years' work in the electrical business, that it is the direct current stations which are paying the dividends, and to invite any of those interested to visit some of the modern plants working on the system which I have outlined.

The Latest Things in Electricity.[1]

By W. W. Low.

The progress and development of electricity has been so rapid in the last decade that things that were new and startling and which caused a great deal of talk and controversy in the electrical newspapers and among electrical men a year ago have almost ceased to interest and have passed into everyday use with us.

If I were to cover completely everything that the title of this paper suggests, I should be like some mathematicians who have tried to find the square root of 2, which has been sought after but never gotten, as there was something always remaining to be done. So I will only call your attention to some of the new things that will most directly interest the central station men.

For the last few years there have been comparatively few really new things. What I mean by that is things that embrace entirely new ideas and new principles in electricity. But the new things, or rather the newly improved things, are many.

As the scope of this paper is unlimited I will try to confine myself to only the new things in electricity which interest "those actively connected with the production of electricity for commercial purposes;" in other words, central station men.

The first and to me the most important new thing to the central station man is the new business policy of the supply houses. Some years ago, when central station men did not know as much as they do now, it was the habit, I won't say policy, of the parent houses and also, I am sorry to say, the supply houses to bleed the station men for all they were worth. This was done in various smooth ways. In the first place the supply houses put men on the road who would guarantee that they were born without a conscience, also born smooth talkers. They were generally "Hail fellows well met." They soon gained the confidence of their intended victim and then proceeded to take him in. They knew it all; the station man didn't. O the prices would be all right. Nothing ever wears out that he sold. The other man didn't know anything about the business. Why, he used to buy hides and tallow (that's how he is such a smooth talker). Line wire? Yes; best in the world; 48 cents per pound. Too much! Why last month it was 52. Next month it may go up to 60 again; all depends on the price of the copper and the insulating material (white lead cotton.) Let's have another drink; I am almost parched talking; you are such a close buyer, etc. And so the talk went on, the poor central station man being done up right and left.

Now let us look at the situation to-day. In the first place, everything is catalogued and every station manager has his discount sheets, and he can tell at a glance what a thing is going to cost him. There are a few honest travel-

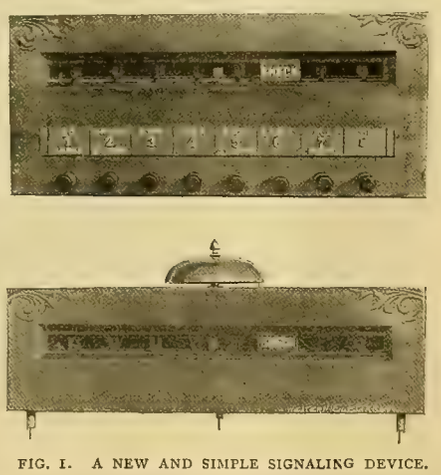


FIG. 1. A NEW AND SIMPLE SIGNALING DEVICE.

ing men, who are experts and can help the station man out of trouble. Fair business policy and proper business dealings, small profits, 30 days and hard collections.

To-day the central station purchaser can sit in his chair and the supply men tumble over each other to get a word in his ear. From being a poor, brow-beaten, humbugged, worried man, he is to-day lord of all he surveys.

Now let us pass on to new material in electricity. First under this head is a new wire. This is an entirely new departure from all the old kinds of covering made for electric conductors. It depends for its insulation upon the cotton just as it comes from the gin, saturated with a high grade of insulating compound. This is loosely spun around the wire and then pressed solid by hydraulic pressure. Outside of this insulating coating is a braided protection which is saturated with a fire and weatherproof compound.

Another new thing in line construction is in transformers; I should say improved thing. The transformers of yesterday were crude. Why you had to fill some with oil to keep them going.

The transformer I now have in mind does not depend on any of these foreign substances for its indestructible qualities, but is made to eliminate the chances of burnouts. The iron, a most important factor in a transformer, is properly balanced with the copper and is a properly magnetically closed circuit. The fuses are so arranged that they can be removed and re-fused without any danger to the operator.

Also an immense stride has been made in high candle power incandescent lamps. It is easy now to make an incandescent lamp of any candle power up to 500 or even 1,000, and by thus massing the light a very much higher efficiency is obtained. The makers guarantee 2½ to 2¾ watts per candle power. Such lamps you can see here to-day.

Now let us turn for a moment to an article that there has been a great demand for, an alternating arc lamp. In the recent past what have they been? The words "alternating arc lamp," made the central station man's mouth water, at the same time it gave him cramps. It conveyed to his mind all kinds of trouble with a very complicated piece of mechanism. If you had told a month ago that an alternating arc lamp could be made simpler than a direct current lamp, and that it would regulate to a finer point, you would have seen a look come into his face which said "I would like to call you a liar, but I won't." But to-day it is a fact, as you can see for yourself. They don't make a noise like a buzz-saw any more, but run quietly with a steady, bright, white light giving 2,000 candle power at an expenditure of 418 watts against 500 watts on the old series system.

Among the very newest things are Tesla's latest inventions, which you no doubt have read of. He promises us

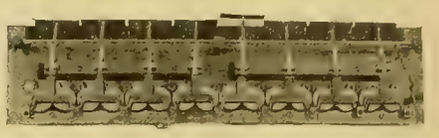


FIG. 3. A NEW AND SIMPLE SIGNALING DEVICE.

light without wires or heat, and in fact has shown the former in his experimental lectures. By his multiphase alternating current system very long transmissions of power are rendered possible, and many large enterprises of this kind are under way or already planned.

1. Read before the Northwestern Electrical association, Milwaukee, January 17, 1894.

A New and Simple Signaling Device.

A signaling device known as the Gruschow signal was placed upon exhibition in Chicago last week, which, by the simpleness of its construction and the success of its operation, attracted considerable attention from marine men, for whose use it is intended. To establish instantaneous and recorded communication between the captain or pilot-house of a steamer and the engine room has always been a somewhat complicated problem, which has as yet been but indifferently solved Numerous systems have been tried upon vessels, but none have filled the requirements demanded of them sufficiently well to bring them into general use.

The Gruschow signal is the invention originally of Robert H. Gruschow of Chicago, and comprises in its operation many merits which will be recognized at once by boatmen. The device consists primarily of two parts: the push button apparatus, coils and automatic set-back placed at the convenience of the officer in command of the vessel, and the recording device to be located in the engine room. As shown in Fig. 1, where these parts are represented, the upper box contains eight push-buttons, which, when operated, throw not only the indicated signal in the lower box in the cut at the engine room, but also automatically register the signal card thrown, so as to avoid any misunderstanding of signals. In Fig. 2 are presented the coils in the boxes with and without signal card connections. Fig. 3, a view of the top of the apparatus, shows more plainly the connection between coils and signal cards. The current is supplied by a primary battery of about 12 cells, and the electromotive force is approximately 15 volts. The current passing through the coils in the captain's box throws into view a signal card; connection is had with the engineer's box, where the operation is repeated. As the signal card flys upward it comes in contact with a small pin, which is so arranged that it automatically releases the previous signal thrown. When the card reaches its proper position it makes connection with an insulated bar, which rings the engineer's bell, which in turn completes the circuit to the captain's bell. Thus the sender of the signal, if the captain's bell rings, may be positive that the engineer has received the signal.

The devices are placed in brass boxes, each 27 inches long, 9 inches high and 7 inches wide. The engineer is also supplied with three buttons, by which he can signal the captain in case of mishap or "all right." He can also confirm any signal sent him, if he so desires, by the pressure of a button which rings the captain's bell, but does not disturb the signal, and signifies that the engine is working in accordance with the signal sent. There can be no misunderstanding between the captain and engineer, as both receive the same signal. The bell on the captain's box is so arranged that it cannot ring until the signal has been displayed to the engineer. In connection with this device a register may be used which will record upon paper each signal in ink, with the hour and minute it was sent, thus making a record of a voyage more accurate than a log book, and one which can be used as conclusive evidence in lawsuits resulting from collisions and accidents.

Polyphase Transmission Plant for the City of Budapest.

The Elektrictaets Aktien Gesellschaft, successor to Schuckert & Co., of Nuremberg, Germany, has just completed an interesting installation for the city of Budapest. The power plant is located three kilometers (9,840 feet) from the city distributing station, and is equipped with two-phase separately excited generators driven by triple expansion engines. The current, at 2,000 volts, is carried in three iron armored lead cable to the distributing station. Each cable contains two concentrically arranged conductors, and as only four conductors are necessary for the transmission of the two-phase current, one cable remains in reserve.

At the distributing station are two phase 1,800 volt motors coupled directly to direct current 110 volt dynamos, arranged on the three-wire system of distribution. Two batteries of 148 accumulators each are connected to the three-wire system. The accompanying diagram clearly represents the manner of operation. *DG* represents the polyphase generators at the power station, *ED* being the exciters and *EM* the exciting magnets. *S* indicates the manner of lighting the station by the direct current of the exciting dynamos, while *L* are the high-tension mains. At the distributing station *DM* are the polyphase motors driving the continuous current 110 volt dynamos *D*. The battery of accumulators is at *A*, and *K* shows the low-tension distributing mains.

The advantages claimed for this system are high efficiency and small copper conductors from the power house to the distributing station. At present there are only two 500 horse power engines and two 500 horse power generators at the power station, although it is expected to treble the capacity of the plant soon. The three-wire system has been laid out for a capacity of 16,000 16 candle power lamps burning at the same time. The polyphase machines have a periodicity of 25 per second. No transformers are used. Special apparatus prevents the peculiar phenomena (Deptford effect) caused by the capacity of the cables. No difficulty has been experienced in connecting the polyphase machines in multiple without artificial load resistances. It is said that the whole installation has been giving excellent satisfaction since it was put in operation.

Moonlight Schedule for February.

Following is the WESTERN ELECTRICIAN's lamp lighting schedule for February:

Day of Month.	Light.	Day of Month.	Extinguish.	Number of Hours.
	H M.		H.M	H.M.
1....	P. M. 5 40	2....	A M 6 10	12.30
2....	" 5 40	3....	" 6.10	12.30
3 ...	" 5 50	4....	" 6.10	12.20
4 ...	" 5 50	5....	" 6 10	12 20
5 ...	" 5 50	6 ..	" 6 10	12 20
6....	" 5.50	7....	" 6 10	12.20
7....	" 6 20	8....	" 6.10	11.50
8....	" 7.20	9....	" 6 1	10.50
9....	" 8 30	10 ...	" 6.00	9 30
10....	" 9.4	11....	" 6.00	8.20
11....	" 10.50	12....	" 6.00	7.10
13....	A. M. 12.10	13 ..	" 6 00	5 50
14....	" 1 30	14 ..	" 6 00	4.30
15....	" 2 40	15 ..	" 6 00	3 20
16....	" 3 40	16....	" 6.00	2 20
17 ...	" 4 40	17 ...	" 5.50	1.10
18 ...	No light.	18 ..	No light.	0.00
19 ...	No light.	19 ..	No light.	0.00
20...	No light.	20....	No light.	0.00
21....	P. M. 6.10	21 ...	P. M. 8 50	2 40
22....	" 6.10	22....	" 10.00	3 50
23 ..	" 6 10	23 ..	" 11.10	5.00
24....	" 6.10	25 ..	A. M. 12 20	6.10
25....	" 6 10	26....	" 1.20	7 10
26....	" 6.10	27....	" 2 30	8 20
27 ..	" 6.20	28 ..	" 3 30	9.10
28....	" 6.20	Mar. 1	" 4 30	10 10
		Total.....		191.40

The foregoing schedule was calculated on the following basis:

Light one-half hour after sunset and one hour before moonset.

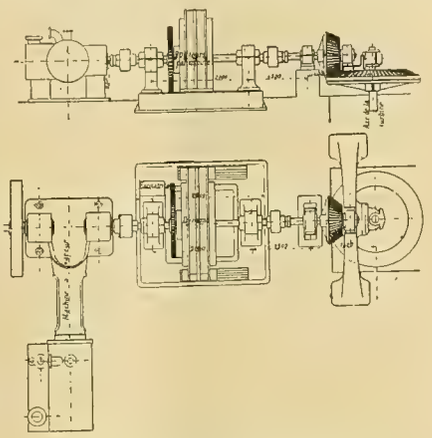
Extinguish one hour after moonrise and one hour before sunrise.

Street Railways in Austria.

It is announced that the company which owns all the street car lines in Budapest, having altogether a length of about 56 miles, has resolved to adopt electricity as the motive power over the entire system. The improvement, it is computed, will take three years to complete. The total cost of the change is estimated at $5,000,000. While the government and municipality are vying with each other in such improvements in Buda pest, the authorities in Vienna, remarks a correspondent, treat that important interest with strange indifference. There are whole districts, especially in the suburbs of this capital, which are still without the convenience of a street railway, or have only partial and very insufficient accommodation of that kind. The populous outer suburbs of Vienna were incorporated with the city three years ago, yet up to the present moment nothing has been done to unite them actually by means of railway lines.

Foreign Water Power Electric Plants.

According to *Le Genie Civil* there has been a notable increase in the use of water power for the generation of electricity in the plant installed by the Oerlikon company for the Neuhausen company, at Neuhausen, in Switzerland. The Neuhausen works, which are near Schaffhausen, and which derive power from the falls of the Rhine at that place, have, until recently, had in use seven dynamos, four of 150 horse power each, one of 300 horse power and two



FOREIGN WATER POWER ELECTRIC PLANTS.

of 600 horse power each. In order to increase the production of aluminum the company wished to increase in a large proportion the production of electric energy, and for that purpose put in four very large dynamos, making, with the three of the largest of its old machines, a group capable of exerting 3,900 horse power. The four new dynamos are run at a speed of 150 revolutions per minute, and give out 7 500 amperes each, at a pressure of 55 volts. The nature of the work at which they are employed, which requires an absolute uniformity of current, rendered the work of constructing these dynamos one requiring much care. The accompanying diagram shows in outline one of these machines; it is vertical and coupled directly to the turbine shaft. At the other end of the dynamo shaft is attached a steam engine for use in case of necessity, as shown in the plan. The turbines were built by Escher, Wyss & Co., Zurich.

In 1891 a syndicate was formed at St. Etienne for the purpose of utilizing the falls of the Loire for the production and distribution of power from St. Victor to St. Etienne. The fall near the city being insufficient, a concession was obtained of a fall on the Forez canal capable of developing 900 horse power with the possibility of a considerable addition. The power station was established at Chatelet, and is provided also with a steam plant in case the water power becomes insufficient in time of prolonged drought. The engines, however, will only be used in cases of necessity. The power station has three groups of dynamos of 300 horse power each, which are of the triphase type. Each dynamo can be driven at will by a turbine or by a steam engine. The axis of the turbine is vertical and that of the dynamo horizontal. The dynamo runs 200 revolutions a minute, and the shaft is connected by couplings either with the turbine or engine. From the power station the wire lines by which power is conveyed, run to St. Etienne in different directions, forming a loop, and having several branches to convey current to various points for power and for lighting purposes. While only 900 horse power will be supplied at first, it is expected that this will have to be largely increased, and provision has been made at the power station for the erection of additional units.

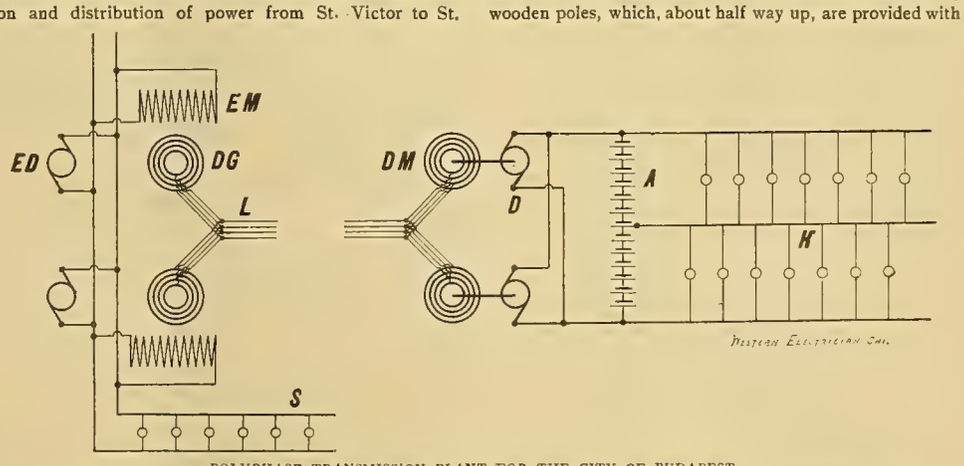
Particulars are given in a recent issue of *Les Annales des Travaux Publics* of the operations of the Société de l'Acquedotto de Ferrari Galliera in establishing electric water power installations near Gênes, Italy, where vast quantities of water have been stored by damming one of the valleys in the vicinity and thus creating large artificial lakes. These are at an elevation of about 1,800 feet above the town, and in order to profitably utilize the power the total head was subdivided by the establishment of three intermediate power stations and reservoirs at different levels. The first of these stations works under a head of about 370 feet of water, affording about 746 horse power; the second has a head of about 355 feet, giving 720 horse power, and the third has a head of about 472 feet, yielding in the neighborhood of 960 horse power. The greatest distance to which the current from these stations is now carried is about 19 miles.

At present the current is used only for power purposes, the constant current system being employed, and the various motors at different points along the line being connected in series. The voltage ranges from 450 or 500 to overcome the resistance of the line when none of the motors are running to as much as 5,000 or 6,000 at the times of greatest power consumption. With such wide, and at times very sudden, changes in potential the regulation of the motors offered problems of special study which appear to have been solved in a satisfactory manner.

The first station at present comprises two dynamos developing together 140 horse power, and driven direct by a turbine working at a maximum speed of 475 revolutions per minute. Elastic couplings of the Raffard type are used. The dynamos are of the Thury pattern, have six poles each, and at maximum load deliver a current of from 1,000 to 1,100 volts and 47 amperes. The speed of the generators varies between very wide limits, according to the voltage to be supplied, regulation being effected by hand.

The second station is equipped with four turbines, each of 140 horse power, and each coupled with two generators like those first mentioned, the field magnets being excited in series by a separate dynamo, which is independently driven by a special turbine. The third station is designed to accommodate six turbines of 140 horse power each, two generators again being coupled to each wheel, and each generator being intended to furnish a maximum current of 45 amperes and 1,000 volts, working at 475 revolutions per minute. All the generators are connected in series.

The current transmission lines are copper wires, about .36 inch in diameter, carried on oil insulators on ordinary wooden poles, which, about half way up, are provided with iron prongs or barbs to prevent unauthorized persons from climbing up. There are also printed notices warning the public against coming in contact with the wires. The motors, which are supplied with current at different points along the line, are all of the Thury pattern, ranging from about 5 to 60 horse power. The smaller motors, ranging from 5 to 18 horse power, are of the two-pole type, while the larger ones, from 18 horse power up, are multipolar, the number of poles varying from four to six. The actual length of line now in operation is about 37 miles.



POLYPHASE TRANSMISSION PLANT FOR THE CITY OF BUDAPEST.

The whole installation, affords an admirable solution of the problem of successfully transmitting high-tension, continuous currents and utilizing them on the series system. The maximum, 6,000 volts, now used at Gênes, does not, moreover, imply that the full limit of high-tension according to this system has been reached, and it is intended to soon further increase the voltage to 10,000 by putting in additional generators.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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WE have tried advertising in several electrical papers, and after discontinuing our advertisement in your journal [*Electrical World*] we advertised for a considerable period in the WESTERN ELECTRICIAN, which we found a valuable paper for reaching the West, our card in that paper bringing us many communications, a number of which resulted in sales of our alternating apparatus, including a plant for the University of Wisconsin.—*Extract from a letter of F. A. La Roche, president of the La Roche Electric Works, Philadelphia, to W. J. Johnston, publisher of the Electrical World.*

A GLANCE at the report of the proceedings of the annual convention of the Northwestern Electrical association at Milwaukee last week shows that that excellent organization is proceeding upon the proper lines and that much good may be expected to result from its meetings. In point of attendance and in the interest shown in the proceedings the Milwaukee meeting compared favorably with any electrical convention that has been held in late years. The papers read were of a most practical character, the discussions were interesting and instructive and the members applied themselves to the business in hand in a way that would put some of the older organizations to shame. The members of the Northwestern Electrical association are to be congratulated upon their successful meeting, and they should be encouraged to persevere in their efforts. The next meeting of the association will be held at St. Paul, and, with the experience gained at Milwaukee, there is every reason to believe that it will be successful in every particular.

AMERICAN engineers will learn with interest that Rankin Kennedy professes to have discovered a new method of electric traction, whereby the great drawback to the present methods is said to be overcome. The losses in, and the great size of the plant required for, electric traction as at present carried on, are alluded to and it is claimed that with the new method the work will be done with a motor of from 5 to 10 horse power. An English contemporary says that the new method is being submitted to American experts, who have much more experience in electric traction than those in any other country. Is it possible that this admission is made with Mr. Kennedy's approval?

"FROM a European point of view," says the London *Electrical Review*, "the electrical exhibits [at the World's Fair] were of little or no interest, and, therefore, as an exhibition, we consider it was a failure." How distressing! We are tempted to believe, however, that in depreciating the electrical side of the World's Fair our English contemporaries find it a case of sour grapes. The part played by Great Britain in the electrical display was so feeble and insignificant that our English critics bite their thumbs at us in sheer mortification. In no other way can we account for such an absurd burst of truly feminine spite as the following:

Only in one thing it was not big, and that was as an exhibition of the science and art of electricity and electrical engineering. This, of course, from a European point of view. We have had so many exhibitions, and have the earliest possible information regarding new departures or new inventions, that it is not to be wondered at that so little of real interest to the profession could be gleaned at Chicago.

The *Electrical Review* has a reputation among its English contemporaries for virulent criticism, but it might be expected that the silly sneer just quoted was even below its level. The electrical engineering of the World's Fair requires no defense from such attacks.

PROBABLY no more perplexing emergency arises in an electrical plant than in the case of disability to the ohm sifter. How can the dynamo tender guarantee a pure, clarified current if his ohms are all mixed up? An accident of this character happened in Hazel Park, Minn., the other day, and we are indebted to the *Times* of that place for the following all too brief account:

The ohm sifter of one of the large dynamos at the Wood harvester works became detached Thursday, thereby causing the ohms and volts to pass over the same wire. Had it not been for the presence of mind of Mr. King, the company's electrician, the automatic ampere controller would have been disabled.

We could have wished that the *Times* went into greater detail. All honor is due Mr. King for his promptness and bravery, but we are left in the dark as to the exact method he employed to save the ampere controller. For ourselves we should recommend the instant stoppage of the dynamo, allowing the rheostat to care for the load temporarily by a suitable connection with the voltmeter. Then the sifter could be again attached to the armature shaft, the troublesome ohms removed from the volt wire, and all would be well again. We are aware that some electricians advocate the use of a transformer for converting the ohms into volts when one wire becomes charged with both, but this involves the widening of the air gap after the field magnets have been removed, which is a rather difficult operation, and one tending to lower the efficiency of the machine. On the whole, we are decidedly in favor of the rheostat method.

Is it to the interest of the trade unions that the telegraph business of the country should be controlled by the government? The Typographical union of Cincinnati seems to think so, for it is foremost in a movement in that city to memorialize Congress to bring about the desired change. The printers argue that the introduction of type-setting machines is a menace to their occupation, which might be counterbalanced, however, by the lower tolls of government telegraphs, enabling small capitalists to engage profitably in news-gathering and journalism, although not on a scale to justify the use of machines for type composition. Aside from the socialistic tendency of governmental control of the telegraphic service, which is repugnant to the great majority of American workingmen, it is by no means certain that the change would work in the manner which the printers expect. The government would undoubtedly aim to make the service self-supporting, and with the interest on the cost and the extensions that would undoubtedly be made to many small places now without telegraphic facilities, it is doubtful if any great reduction would be made in the already low rates granted to newspapers. And it should also be remembered that the expenditure for transmitting the messages is only a portion of the cost of collecting telegraphic news; the expense of actually obtaining the news and delivering the "copy" to the transmitting office would remain the same as at present. It is also a fact that the state telegraphs of Europe do not appear to have resulted in increased employment for compositors. We do not think that the printers of the United States would be materally benefited by the step that a few of them are so strenuously advocating.

PROF. ROWLAND'S action against the Cataract Construction company, was tried in New York city last week, and resulted in a substantial victory for the plaintiff. The case attracted much attention on account of the eminent standing of the experts called as witnesses and the recent controversy over the plans approved by the company and the methods employed in securing them. It will be remembered that Prof. Forbes, the representative of the company, published the details of the project in a paper read before the Institution of Electrical Engineers at London. This was looked upon by American engineers as a slight, inasmuch as the undertaking was essentially an American project. The report of the criticisms by the English engineers were read by Americans, therefore, with perfect composure. Moreover, it was openly charged that the company had not dealt fairly with the designers and manufacturers who had submitted plans and specifications for the work. It was asserted that the suggestions of many of them had been utilized by the company, and that the best features of many of the plans submitted had been combined in the plans finally decided upon by the company. When Prof. Rowland brought action against the company it was believed that many interesting developments would be brought out on trial, and in this the attendants at the sessions of the court were not entirely disappointed. It was shown that there was considerable friction between Prof. Forbes and Prof. Rowland, which at one time seriously interfered with the progress of the work. The report of the court proceedings, taken from the official stenographer's notes, will be read with interest. It is certainly to be regretted that such a gigantic enterprise should be hampered by bickerings and petty jealousies among the experts, and small dealing on the part of the company.

ONCE more the Rapid Transit commission of New York has returned to the consideration of the underground railway project, this time at the solicitation of Banker Wilson who believes he sees a way out of the difficulties that have heretofore made the building of the road impracticable. It will be remembered that Mr. Wilson, representing a syndicate of capitalists, appeared before the commission a few months ago, and proposed that the city enter into partnership with his clients in furnishing the financial backing, necessary for the construction of the road. It was pointed out at that time that such proceeding would be unconstitutional, but Mr. Wilson now proposes to secure relief through the assistance of the constitional convention, which will be held next summer for the purpose of revising the constitution of the state. In fact he bases his plans on the expectation that a special provision will be made by this convention enabling the city to assume part of the obligation. Such proceeding would be unusual, and would give the opponents of the project an opportunity to make a popular fight against the measure. The people of New York do not like the idea of opening the way for special legislation of this kind. The city has hitherto kept out of such schemes, and as a result the credit of the municipality is very high. Mr. Wilson and his associates understand this fully, and they, of course, appreciate the value of the city's endorsement. They know that they can secure loans upon much better terms if they are guaranteed by the city of New York, than if they were to present only their personal security. It is hardly possible that the people will like the idea of the capitalists using the city's credit without compensation.

However, the scheme has many features to commend it, and it should receive due consideration. If there is any hope of securing a practical system of underground rapid transit for New York, the projectors should be encouraged and assisted in every proper way.

The Niagara Transmission Undertaking.

This magnificent scheme, which, if it had only been in successful operation during the World's Fair, would have been a climax in electrical development as far exceeding the Frankfort–Lauffen experiment as that exceeded all its predecessors, has not brought the comfort and solace to those who have been responsible for it that was hoped or reasonably to be expected. The first public sign of trouble was created when Prof. George Forbes, the English engineer most prominently connected with the development of the plans, deliberately passed his American confreres by and made known the details of the plan to an English audience. It seemed indeed strange that an American project in American waters depending entirely for its customers upon an American clientele—a project which was in every way American from its inception to the awarding of the contracts for its electrical machines, built on lines distinctively American—should be first authentically described to a foreign audience; and there are many who claim that this was a direct discourtesy to American engineers. However this may be, the worst enemy of Prof. Forbes could scarcely have wished him a worse fate than he received at the hands of his associates of the Institution of Electrical Engineers in London, for they spared him neither by tooth nor by nail, as is learned from the later English papers that have been received.

Nor was the Niagara Construction company held guiltless by our English censors in the methods adopted to collect information for its guidance, and it would seem from the reports already received that no one of the many world-renowned engineers of whom we hear so much on this side of the Atlantic had a kind word for Forbes, or was brave enough to take him by the hand and say "I will defend this man, even if he has made some mistakes." It would be impossible for Prof. Forbes, even after he had shown American engineers the discourtesy claimed, to have received at the hands of the latter such a wholesale "roasting" as he received at the hands of his fellow members of the Institution of Electrical Engineers in London. But this is not all. It seems that there has long been a skeleton in the closet of the engineers employed to work on the plans, and this at one time took such a form as to prevent Prof. Rowland of Johns Hopkins and Prof. Forbes from communicating with each other even on professional matters. It also seems that Prof. Rowland was called upon at times, in his official capacity, to criticize the work of Prof. Forbes. And, again, it now becomes common gossip that when the plans and specifications were finally settled upon and they were submitted to the Westinghouse company, the latter refused absolutely to have anything to do with them as they stood and they had to be materially revised before that company would consent to be a bidder.

But all this might have remained *sub-rosa*, had not the Niagara Construction company conceived that it had a right to criticize Prof. Rowland's bill for services. He presented a bill for $10,000, covering six months and two weeks' time. This was thought exorbitant, and a check for $3,500 was sent in return. Prof. Rowland became much incensed at this and made out another bill for $30,000 and presented it. Upon this producing no results, he sued the company for the amount, and the trial came off before Judge Shipman and a jury in the United States Southern District Court of New York.

Among the witnesses were Prof. Duucan, Lieut. Sprague, Wm. Stanley, Wm. R. Rankine, William W. Jacques, Prof. George Forbes, Prof. Rowland and Mr. Sellers.

These, together with many visitors who just dropped in, made quite a galaxy of electrical luminaries, such as is seldom seen together, and it may be truly said that electrical circles have never been so much agog as they were last week.

The trial commenced on Wednesday morning of last week, with Prof. Rowland in the witness chair, and the following is the story in brief, chiefly from the stenographic notes:

In 1889 Rowland was asked by Mr. Adams, who was about to form a construction company, to make a report. Rowland suggested Dr. Duncan, but Adams insisted on Rowland, who mentioned his price in an off-hand way and finally did the work. He found it amounted to considerably more than he expected at first, and never considered he had received adequate compensation for it.

On August 23d he received a telegram from Adams, asking him (Rowland) to meet him in New York, which he did, and during their conversation Adams said that he wanted him (Rowland) to go over the plans of Prof. Forbes. The company had $50,000 lying idle and was very anxious to come to a decision about the electrical machinery. Rowland was desired because he was totally unprejudiced in regard to the several systems.

Rowland consulted with Forbes a few days and then returned to Baltimore, where all the plans were subsequently sent him. There were eight or ten plans submitted, and these were immeasurably larger than anything he had seen before.

He then described the tunnel and amount of power to be developed to be used directly as power. The question, he said, to be solved was the form or type of electrical machinery to be used.

He stated that he had been engaged at the work from August 27th to March 6th, six months and two weeks, and during this time had put in about seven hours' work daily.

The first question he had had to pass on was whether to use continuous or alternating currents and some disputes as to local distribution.

The next question was as to the frequencies. In regard to this there had been some difference of opinion. Forbes had proposed 8 2-3 periods; he himself had suggested 41 first and then 33. He had then met Tesla and conferred with him as to the operation of his motors and at what frequencies they worked best in order thus to help decide the frequency.

The next question that arose was as to the weight of the revolving parts. Forbes recommended very light armatures and revolving parts. He had recommended parts as heavy as possible.

Another question was as to whether they would use transformers or not, and if used as to the cost per horse power of the same.

Prof. Rowland said that Mr. Adams told him that he considered him (Rowland) his chief adviser.

Speaking upon his previous expert work, Dr. Rowland stated that he had made a report on the Stanley motor for $1,000. It took him and Dr. Duncan a week to arrive at their results.

He said that he had objected to criticizing Forbes' work, but after further consideration and some talk with Mr. Rankine, secretary of the Niagara Construction company, he came to the conclusion that it was necessary for his own honor to put his criticisms of Forbes' plans in black and white, and he then sent it to the company, but gave it no publicity outside of this. The first report of this kind was sent on March 1st and the second on March 8th.

His bill of $10,000 was sent in two or three weeks later. The bill was questioned by the company, which claimed the amount was exorbitant and more than usual for expert work of that character. His bill did not include any expenses but was simply a charge for services.

Dr. Rowland was cross-examined by Mr. Choate, who at once put the witness into an embarrassing position by compelling him to state his own estimate of himself.

Q. You say in your letter of April 4, 1893: "In my acknowledged position as the first physicist and electrician in this country"? A. I am of that opinion now.

Q. Had you been in the habit before when rendering bills of rendering a bill that you thought just and reasonable and afterward demanding three times as much? A. I never had occasion to, because I never had anybody to dispute my bills before.

Dr. Rowland, being asked if he remembered when he first began to practice as an electrical engineer and expert, said that he did not. Upon being asked on what occasions he had acted as an expert and what he had earned, stated that he had earned $1,000 from the Sprague company, and that it was his impression that the services for which he was paid occupied two months. He had also been employed by the United States government, about three years ago, on the wires in the District of Columbia. For this he got about $4,000.

He had been employed also by the Weems Electric Railway company to look over its plans, and had received $500 for this. Dr. Duncan and he had received the same amounts for all these jobs. Dr. Duncan did all the work and he (Rowland) had written the opinions.

Q. You he'd the light and he did the work—is that it? A. That is about it.

Dr. Rowland stated that in rendering his bill he meant to practically measure it by his past prices for services. He calculated to make about $60 a day for 6½ months. His salary at Johns Hopkins was $5,000 a year, requiring less than one hour a day of work.

His preliminary report to Mr. Adams (on general questions) took about two months. For this he received $1,000, and there was no complaint of the charge, nor had anything been said about the rate of compensation in the second case, and it might be supposed that his second services would be measured at the same rate. He denied ever having entertained the idea of making up in his second bill what he believed was lacking in the first.

It was stated that Sir William Thomson, Coleman Sellers, Theo. Turrettini, Mascart and others had sat in London in June, 1890, as a Niagara commission. The questions first asked were intended to show the relative standing of these gentlemen in the scientific world, and latterly to show what they severally received for their services. It developed that they were occupied for several months and that each received £500, or about $2,500, for his services.

Dr. Rowland stated that the result of these deliberations was to advance the state of the art to where it was when he commenced his work. He further said that a large part of his own personal work or services consisted in showing up the mistakes of Forbes, and that the rest was comparatively routine work which could be done by any fair electrician. The Niagara work did not interfere with his regular work at the college.

When the hearing was resumed on Thursday Prof. Rowland was further cross-examined. He said:

Your honor, I would like to make one correction in my statement yesterday in respect to the report of Prof. Forbes. I testified that I had shown it to Dr. Duncan. I remembered afterward that I did not show it to Dr. Duncan. It was one which the company had requested me to keep confidential, and he has only seen it now as it appeared upon the table. I did not show it to him at all.

By Mr. Choate: Q. In stating your qualifications yesterday as an electrical engineer and expert, of course you did not state all you had previously done in that direction? A. In the direction of electrical work the list would be very long indeed.

Q. And in other directions you had been an inventor? A. Yes.

Q. Had you, among other things, invented a flying machine? A. When I was a boy. I have that down in my note-book. I have a small drawing of it.

Q. I now read to you from the stenographer's minutes, coming to the subject which we were at when we adjourned—your conversation with Mr. Adams at the beginning of this employment. He then said it was very important that they should come to an immediate decision, as they had built this tunnel, and, of course, the tunnel was lying idle there, and it was very important that they should obtain some advice and come to a decison upon the type of electrical machinery there. Is that correct? A. That is the substance of the remark.

Q. He said further: "The amount of loss per year was something like $50,000, as the capital was lying idle, and it was immensely important that they should obtain this advice and get the dynamo started." Is that correct? A. He did not use those figures. I said that was the substance of his remarks. The idea given out was of that nature yes.

Q. Do you know now that the tunnel was not completed until six months after that time? A. I know it was very near completion, and the greatest amount of money had been expended upon it.

Q. Do you know it was not completed until six months after that time? A. Yes; I understood so.

Q. Then did he say to you that they had built the tunnel and it was lying idle there and the loss was $50,000 a year? A. The portion of it that was built was lying idle, certainly.

Q. You consider that a tunnel half built is a tunnel lying idle and that he said so? A. I consider that that was the substance of his remark, in which he said, as I understood him, that the turbines were very nearly completed, or the contract had been given out, and the dynamo was to be put down.

Q. You say further that he said that the turbines had already been ordered. Do you know, or not, that the turbines were not ordered until three months after that conversation? A. No; I understood from him that they had been ordered, at least that they had been decided upon; and I understood from that that they had been ordered.

Q. Did he say they had been ordered? A. I gave his remark as nearly as possible.

Q. Coming now to the making out of your bill for $10,000, did you make that out after deliberation? A. Yes; after a great deal of deliberation.

Q. Before making it out did you have a conversation with one of the officers of the defendant company about the plan on which you were going to make it out? A. I had a conversation with Mr. Adams about it.

Q. Did you have a conversation with Secretary Rankine? A. Yes, although I consider that a private conversation.

Q. Did you say to Mr. Rankine that you thought you had not been paid enough for your former service? A. Yes.

Q. And did you say you were going to make that right this time? A. No; I did not say that.

The witness afterwards corrected himself and admitted that he had made that statement in substance.

Q. Did you say that, in connection with the statement that you had not been paid enough before, and that you were going to make it right this time? A. Yes; in the same conversation certainly.

Q. Did you also ask him what fees the company was in the habit of paying? A. No; I don't remember asking him that.

Q. Did you not tell him that you were going to make a very full bill to the company this time? A. A very full bill? I said I was going to have a just bill.

Q. Now, you have stated that you made out your report in respect to Prof. Forbes, that you came to the conclusion that you sought for your own honor to make it out, and also that you made it out for your own protection? A. Yes.

Q. Did those sentiments inspire you when you were writing that report?

A. They partly did. In addition I had given to the company from time to time verbal reports upon this report of Prof. Forbes. I had told them that Prof. Forbes was absent and if I gave them a verbal report I did not wish them to consider that I was coming around there in a sneaky way, as it were, giving them information; that I was not afraid that Prof. Forbes should know about it and should criticize. Therefore, when I saw that the company had some doubt about the matter, I thought it was advisable for me to put that in as the company had requested. I had refused to do it at first, and afterward they rather forced it upon me in this way.

Q. Did you understand at the outset that you were employed to do this service in consultation with Prof. Forbes and Dr. Sellers? A. Yes.

Q. Did you almost at the outset become irritated with Prof. Forbes? A. Yes, sir.

Q. Did that irritation rise to such a degree as to interfere with your performance of the service?

A. For a short time it did, but not afterward.

Q You have told the jury that you worked seven hours a day on every working day from the time you undertook this employment until you made your report. Is that correct? A. The average is correct. Some days more and some days less.

Then follows a long interlocution showing that the witness had spent a couple of days at the meeting of the National Academy of Science, and that he had gotten out a patent on a method for cooling transformers, and had made a series of experiments to determine the effect of vibration upon shafts. It was also shown that both the General Electric company and the Westinghouse company came to him to procure the right to use his invention.

The court finally said:

I ask, if it is true that the company desired some of your patents free, which you refused to give them and what those patents were, and when they made the request and when you made the refusal?

A. The exact dates of those are shown in the correspondences, as well as by word of mouth; that is all I can say.

Then the various features of Prof. Rowland's recommendations were brought out by wearisome questions, seeming to have no particular object in view.

Q. Now I come back to your unhappy bill of particulars again. You say: "I will give some of the reasons for my claim to large compensation. First, the proper form of curve of electromotive force." A. Yes.

Re-direct by Mr. Marbury: Q With reference to the time spent upon this work you have stated that you had an average of seven hours a day to devote to it. Was any of your time at night occupied upon the same work? A. Yes; I often worked nights on it.

Mr. Choate: He said he laid awake nights.

Q. I do not mean lying awake nights. Did you do any actual work and study at night? A. Yes; I would often take the work home and work at it at night, as my mind was so full of it I could think of nothing else except this problem.

Q. Mr. Choate asked you whether or not the dynamos and the electrical installation finally adopted by the Cataract Construction company and contracted for by it with the Westinghouse company does not correspond substantially with the plans recommended by Prof. Forbes.

Mr. Choate: Not in that report.

Mr. Marbury: In any report? A. We have not seen any report in which that was recommended.

Q. Will you state whether it is a fact that the Westinghouse company absolutely declined to bid upon the plans and specifications?

Mr. Choate: I object to that on the ground that it is something that the witness cannot know.

The Court: It is probably true that he could not know that of his own knowledge.

By the Court: Q. You know that by hearsay? A. By a letter from the Westinghouse company printed in the journals, in which they said that.

The Court: Then you cannot testify to it of your own knowledge.

By Mr. Marbury: Q. This is Prof. Forbes' report, is it not (handing paper to witness)? A. Yes.

The counsel for the plaintiff offered in evidence the report of Prof Forbes, dated September 16, 1892.

The question was asked whether Prof. Forbes' report did not embody the essential features of Dr. Rowland's plans. It was finally decided to leave this matter entirely to the jury.

After a re-cross-examination by Mr. Choate in regard to the government contract before referred to, the counsel for the plaintiff read in evidence a statement of Dr. John Hopkinson, which brought out the fact that he usually charged three guineas per hour for his services as an expert. His opinion of Prof. Rowland was of the very highest. An endeavor was made to get him to put an estimate on the value of Rowland's services to the Cataract Construction company, but failed.

Dr. Louis Duncan was next examined—first, as to the hours employed by Dr. Rowland on his work, which he said were from 10 to 6 usually; second, as to his knowledge of practical electrics, to which he certified; third, as to his own part in joint work with Dr. Rowland, in regard to which he testified that his own part was always a subordinate one.

Frank J. Sprague was examined on pretty much the same lines. After having rehearsed his own career. Mr. Sprague was then questioned:

Q. Do you know the position occupied by Sir William Thomson or Lord Kelvin? A. Yes.

Q. And Sir John Hopkinson? A. Yes.

Q. And Prof. Rowland, this plaintiff. A. Yes.

Mr. Choate: That is not disputed in the least. We have nothing to say against Prof. Rowland's reputation. We admit that he is as good as anybody, only we say that the work he did for us was only worth $3,500

Mr. Wise: God help me from any such admission as my friend, Mr. Choate, makes. Why, he has sneered his admission into the heart of my client, and I don't want any such admission. I claim the right to prove.

The Court: You have the right.

Mr. Wise: There is nothing in the world like the evidence of the affidavit countenance of my friend, Mr. Choate, when he refers to Prof. Rowland as the first physicist in the world, and I hope he will never refer to me as a lawyer in the same way, because I think a good deal of testimony would be necessary to overcome that countenance.

Q. Now, I want to know if you are an expert on any other question; on the compensation of experts in America, for instance. A. Yes; I know something about it.

Q. Do you claim to know what is the reasonable compensation for an electrical expert on matters such as have been testified to here? A. Yes.

Q. Will you state what the position of Prof. Rowland is in the electrical world as an expert? A. He is considered one of the ablest scientists in the world.

Q. With your knowledge of his position, and your knowledge of what is reasonable compensation, and your knowledge of what he has been called upon to do in this case, will you state to the jury what, in your opinion, is reasonable compensation for his services?

This question, as put, was objected to, so it was repeated as a hypothetical case. This finally resolved itself into what would be reasonable compensation for an electrical expert employed to pass on certain plans with the conditions attached to the case at issue, the installation involving an expenditure of not less than $500,000.

A. If on a piece of work which did not require original research and invention, I should charge five per cent. on the amount involved. If it required original work, involving material changes, I should say from 7½ to 10 per cent. In this particular instance, I would not give my own time for six months for less than $20,000.

Mr. Choate: I move to strike that out. We did not employ the witness, because we knew he was too high-priced

Mr. Wise: I consent that it be stricken out.

The Court: Strike it out.

Q. State what, according to your judgment of the prevailing tariff in America, the service would be worth.

A. On half a million dollar plant it could not have been worth less than $25,000, on the ordinary charges that people make for preparing plans and supervising work.

William W. Jacques testified to rates paid electrical experts for services, which in some cases reached 10 per cent.; also called upon to estimate the value of Dr. Rowland's services, he placed them at $37,500.

William B. Rankine, secretary of the Cataract Construction company, was the first witness for the defense. He explained in detail the organization of the company, how the experts and commissioners had been chosen, their duties and their pay. His recital was an exceedingly interesting one, giving for the first time a complete history of this great undertaking. In regard to foreign competition, about which so much has been said recently, he said in reply to the question: "What two difficulties were there in the way of accepting foreign plans?" that the tariff was one and the other was the disadvantage of having electrical machinery manufactured for their purposes so far away that the company could not have any supervision of it. He testified also that there was a great deal of irritation between Forbes and Rowland in those days.

Q Which were the most complete plans submitted by your company to Prof. Rowland? A. They were those of the General Electric company and the Westinghouse company.

Q. Were they accompanied by guarantees? A. They were accompanied by proposals for manufacturing and a guarantee of the efficiency of the machines and performance.

Q When was the Westinghouse plan submitted first to Prof. Rowland? A. It was sent to him on the 11th of February, 1893.

Q. When was the General Electric plan submitted to Prof. Rowland? A. It was sent to him on the 25th of February, 1893.

Q Mr. Rowland's report was received by the company on the 8th of March? A. It was.

Q. Did the company adopt the plan embodied in the report of or recommended by Mr. Rowland? A. It did not, as far as I am able to judge.

It appears that Prof. Forbes made a report to Dr. Rowland on September 16 th, involving among other things the frequency to be employed. He also afterward made a number of reports, and subsequently made a design for the type of dynamo which he recommended.

Mr. Sellers also made a report on the plan about the same time Prof. Rowland's report was received. Mr. Sellers' and Prof. Rowland's reports were all received in the early part of March, 1893.

On the 5th of May, 1893, the board of directors decided not to adopt any of the designs which had been submitted to these three technical advisers, and instructed Prof. Forbes, with the advice of Dr. Sellers, to prepare a design of a 5,000 horse power dynamo, with specifications, to be submitted to American manufacturers for their proposals for its manufacture.

The final design was that of Prof. Forbes, and approved by Dr. Sellers.

Q. Who were the scientific advisers of the company at that time when the designs were prepared and submitted to the manufacturers? A. Prof. Forbes was the chief electrical adviser, and the designs were made by him. Dr. Sellers was then acting as chief engineer of the Niagara Falls Power company, with the duty of passing upon anything which the Cataract company submitted. Col. Turrettini, of Geneva, happened to be here at that time, and he also helped us.

Q. And was it by the joint advice and approval of these three that the design was adopted for submission to the manufacturers? A. I don't know that Col. Turrettini took any part in the design before it was submitted to the manufacturers. He assisted us on the decision of the award to the Westinghouse company.

An attempt was made to find out the contract price for the machines, but the witness was allowed to state indefinitely that it was less than $50,000 for each of two 5,000 horse power generators.

The witness stated that he had paid for services rendered on the International Commission as follows:

Lord Kelvin, president of the commission, £500 with a few pounds additional for disbursements, but the charge for his services was £500. Prof. Mascart, £400 and a few additional pounds—the £400 being his charge and the additional sum his disbursements. Col. Turrettini, 400 and odd pounds, and Prof. Unwin 400 and odd pounds, the charge of each of these three being £400

Dr. Coleman Sellers followed and gave a full official statement of everything which the preceding witness could not well give. He also explained the model upon which the order had been given to the Westinghouse company. He also described how the foreign commissioners, including Lord Kelvin, were induced to act.

William Stanley was next called to prove when the first resort to artificial cooling of transformers had been made. He attributed it to J. B. Fuller somewhere about 1870. He believed, however, that up to 1890 no apparatus had been devised suitable for the Niagara transmission schemes.

Next came Prof. George Forbes. Several pages of the record are taken up by statements as to how he had become connected with the Niagara work and other things already known.

Q. Do you know whether at that time (1892) there were any eminent electrical engineers in America who were not connected with some of the great electrical companies like the Westinghouse and the Edison company? A. I believe that most of them had some connection of that sort.

Q. Will you state briefly what your plan was that you presented before the International Niagara Commission in 1890? A. In 1890 the plan which I submitted to the International Commission was to use alternating currents and to generate the current at 2,000 volts and to use that pressure for the neighborhood and to employ transformers to step up the pressure to 10,000 volts for transmission to Buffalo; and I proposed to employ the alternating current in two phases; and the motors which I proposed to be adopted included the synchronizing alternator, which is a well-known type now, and also the two-phase motor which I had had an opportunity to inspect and test at that period.

Q. Does the plan which has finally been adopted and for which orders have been given by the defendant company in substance embody the features which you have stated as contained in your plan of 1890? A. All of its general features.

The judge, after hearing the closing arguments on Friday, gave his charge to the jury, which was exceedingly favorable at every point to the plaintiff.

The jury retired and subsequently returned a verdict for the plaintiff for $9,000 less $3,500, leaving the amount of the verdict as recorded $5,500.

The defendant moved for a new trial on exceptions and minutes. The motion was denied and exception was taken by the defendant. The defendant was granted a stay of 60 days after entry of judgment.

Incandescent Lamp Litigation.

According to a private telegram received at Chicago on Tuesday, Judge Ricks of the United States Circuit Court has dissolved the injunction against the Buckeye Electric company without bonds. The company's representative in Chicago says the decision was based on the claim that the Edison patent expired November 10, 1893. The decision is regarded as an important victory.

In the case of the Novak lamp, alluded to in the WESTERN ELECTRICIAN of January 13th, it now appears that the press reports were erroneous. The injunction was not granted, and the company was permitted to continue the manufacture of lamps upon filing bonds in the sum of $10,000 pending the result of the trial.

The Practicability of Electric Conduit Railways.

By Albert Stetson.

Part II.

THE BENTLEY KNIGHT SYSTEM.

We have already referred to this ill fated method. They failed, but they made a noble fight. They had talent, experience and money, and they did thoroughly demonstrate that a conduit road using a bare wire cannot operate commercially in our American cities. I do not say that it is impossible to find men who will still put their money into such systems, nor do I maintain that men cannot be found to spend shareholders' money in such experiments, but persons working in that direction can well learn from the sad experience of the investors in the Bentley-Knight road. The laws of electricity have not changed since then; no great improvements have been made in insulating bare conductors; and, although I have examined a number of conduits with bare conductors, none of them have shown better construction, such expert technical skill, such regard for the laws of electricity, and none came nearer success. It is the same old story, too great expense and the impossibility of insulation.

In this system there is a conduit between the rails, provided with a slot, through which passes a brush for making contact with the bare wires laid in the conduit. They use a constant potential, about 500 volts being the normal voltage. The current strength is about 7.5 amperes, and the motor used will stand 60 amperes for half an hour. The electrical equipment is mounted on the truck, entirely independent of the car body, and the car is started and controlled precisely as the trolley car is. Fig. 1. shows the essential features of their construction, and at the left is shown a diagram of the conduit and the "plow." The "contact plow" is illustrated in Fig. 2. "It consists of a flat frame hung from the car by transverse guides, on which it is free to slide the whole width of the car, and extending thence down through the slot of the conduit. It is provided with a swivel joint, so as to adjust itself to all inequalities of road or conduit. The frame carries two flat insulated conductor cores, to the lower ends of which are attached, by a spring hinge, small contact shoes of chilled cast-iron that slide along in contact with the two main conductors. At the upper ends are attached flexible connections to prevent flashing at the contact." This road was worked in the winter time during the season of 1884–5. The insulating support is "of vitreous material having supporting pins sealed in it for connecting it to the conductor and to the wall of the conduit inclosing the conductor, and having a flange at its base for protecting the conductor from the moisture that may accumulate upon it or the walls of the conduit. To prevent the water coming in through the slot from causing a leak from the conductor to the metallic conduit, the insulator is provided with a watershed flange at its base, which is preferably curved outward on the form of a saucer, though any suitably-shaped flange may be employed, and the insulator extends out horizontally from the conduit, so that the flange occupies an upright position." This is taken from U. S. Patent No. 455,339, of July 7, 1891, to Walter H. Knight, and further on in the same patent Mr. Knight sounds the keynote of the entire situation, and shows the rock upon which he and others using the same system have wrecked their barks. He says: "It has been found that upon the insulators there is apt to be an excessive condensation of moisture, owing to the fact that the conduit is beneath the surface of the street, and that at certain times an excessive leakage is apt to occur at certain ones of the insulators," and he goes on to say: "This leakage has a tendency to correct itself, that is, the heat engendered by the passage of the leaking current dries up the moisture which has given rise to it."

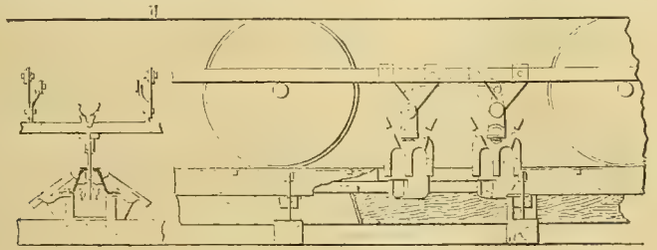


FIG. 1. THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.—BENTLEY-KNIGHT SYSTEM.

True, but that is rather an expensive drying process. Electric energy costs money to produce, and it loses as its distance from the prime motor increases, and then to use it for keeping the streets of cities dry (for it really amounts to that) is hard on the coal pile and the anticipated dividends! The Bentley-Knight conduit system was the harbinger of better things. Splendidly constructed and well managed, but working on the wrong principle, it stands to the commercially practicable conduit road of the present and the future in about the relation of the telephone of Philip Reis to the finished product of Professor Bell's genius.

Of the Love system, now working in Washington, I have not been able to get any accurate or reliable information, and I have heard no favorable reports thereon from impartial authorities. Their conduit, Fig. 3, is well built, their road is level, and their wires are protected in the same manner as failed to protect the Bentley-Knight conductors. The details do not appear to have been worked out so completely as they were in the Bentley-Knight system. About Thanksgiving of last year I was in Chicago, and took occasion to visit and inspect the Love railway. It was not running at the time, had not been, I was informed, for a couple of months, and it was exceedingly doubtful when it would start again. I saw a plain, level piece of track, one-half to three-fourths of a mile in length, over which two cars were to be run, and at the power house a generator of 125 horse power. Now, gentlemen, that is not practical electrical engineering. There is the same bare wire in the conduit, and, until the laws of Nature are changed, there must be the same difficulties that have frustrated other attempts in the same direction. Of the Chicago conduit road Crosby and Bell say, page 256: "The general character does not insure immunity from the difficulties that have caused the abandonment of similar attempts in the past."

The Trend of Electrical Investment.[1]

By H. C. Thom.

Electrical interests have been handicapped because commercial colleges and high institutes of learning have not incorporated in their curriculum, "How to become receivers."

The unparalleled business depression of 1893 has undoubtedly impressed professional men, who so well understand commercial problems in text books, that future courses of study will properly guard the needs of trade.

The pulse of the moneyed public beat high with the "oil fever." Hard earned dollars from the farms of Illinois and from the banks of New York rattled merrily en route to Oil Creek dropping down the dark shaft with a gentle good-by forever. Crisp certificates from mortgages and bonds fluttered about the skeleton derricks and circled downward from human sight with a melancholy sweep. The poor who came back from the Pennsylvania pilgrimage could quell a riot at Bay View or carry Ohio for the Democratic party.

I have a friend who tenderly took a small bottle from his desk one day with the remark "That cost me $17,500; 'tis a legacy for my children." The label was turned for me to read. "Crude oil, 1864." What a story was implied in that simple symbol.

I am of the opinion that more skeleton "crude oil" bottles for 1893 and 1894 are being blown to-day in the electrical field than were molded in 1849 and 1864. It is but a little time since the wizard hung a lamp in Menlo park, and but a little time since "trolley" was coined fresh and bright from the mint of language.

Corporation after corporation, company after company, limited and unlimited, have knocked urgently at the door of secretaries of state for franchises and privileges. Uncounted millions have sought investment in generators, dynamos, copper wire and T rails. Lawyers can be found who, upon becoming students in foreign tongue, could draft organization articles and set the new enterprises in legal motion. We are upon the highest point of the grade. Everything is ready. Engines puff impatiently and their shoulders tremble in anxious strength for the load. The station is a picture of glittering marble, burnished brass and polished steel. The boilers with their red glow are ready to send leaping energy through the labyrinth of intricate wires. The track leads here and there through the main thoroughfares with its arms of iron bolted to the solid earth. Switches and curves, spurs and sidetracks, are masterpieces of mechanical skill. The car, "a thing of beauty and a joy forever," stands ready for her life race. The signal is given. The steady hand of a brotherhood engineer is upon the lever. The wheels move as he knew they would, for he knows the truth and he is master. The motorneer comes from a distant city. He has experience. He is careful, alert and sober. With hand upon controller and brake, with steady eye upon the grade he hears the two bells. A slight movement and the descent begins. With infinite care he safely delivers his precious freight of enthusiastic men and lovely women at the end of the journey. Day after day, month after month, this goes; on in sunshine and storm, in mud and sleet, in heat and cold, the faithful employe runs on schedule time. The engine may break down in harness, but a substitute is ready. Supply men tell us that there is nothing like having a reserve, and so we buy. An armature may short-circuit and burn; another takes its place. Nothing seems impossible. Supply houses love the public and are therefore constantly alert to replace any broken machinery at a moment's notice and at bed-rock figures, so that the dear people shall not walk. The conductor and his little nickel box reports at the office the number who have ridden who have no passes. Everything is lovely. Of course the road is a success. The public claps its approving hands. "What a splendid thing for our city!" A year rolls round, a common stockholder, who has but little business to talk anyway, but who earned the $20,000 he put in by hard knocks, inquires at a regular annual meeting, what dividend he is going to get on his $20,000. "The idea; I always heard he was an awful close man." "Why, my dear sir, this is the end of the first year's business. We expected to lose money the first year. We are going to increase our capital $100,000. What for? Why bless you, if we run twice as many cars we will get three times as much travel. How do we know? Don't you understand that if you embark in electrical business you must have faith." The old man speaks again. "If we lose money on a capital of $100,000 how do you expect to make money on a capital of $200,000?" "What impracticable ideas the old man has! I don't think he is a very good business man anyway. By increased travel, can't you see?" "Yes, I suppose so," the old man reluctantly admits. When it comes to increasing the stock the old man has to stand in and takes $10,000 additional stock.

At the second annual meeting the books show that the additional capital stock has been expended in construction and equipment, and the concern has a floating debt of $21,000. The old man is getting nervous. Reports from the superintendent show that the boilers are out of repair. Three new arches must be put in. The condenser was never a good one. Not the right make. We ought to have a new one. The motors are not large enough to carry trailers. Besides, they are making a new armature now that can be rewound at the station. Unless certain changes are made at the power house insurance rates will go up forty-five per cent. "How much will this cost?" timidly inquires the old man. "I haven't looked that up yet," says the manager. "How are we going to pay our debts and make all these changes?" says the old man. The answer was ready, "Why, bond the plant, of course! Nearly everyone is doing that, nowadays." In his mind's eye the old man sees the bondholder swooping down on his little $30,000 like a fish eagle on an innocent perch. He is getting desperate. "I'll not consent to bond it." "Very well, sir, then the stockholders must give an individual note to raise the money to pay off the floating debt and make the necessary changes." The old man says in a sad voice, "I'm afraid that this thing won't pay twenty-five per cent., as I thought it would when I put in my money." An idea comes to the old man. "How much does it cost us to get one horse power out of lightning for one hour." The manager and the superintendent look at the old man in silent pity. But the old man is morbidly set on this matter and insists on an answer. "Of course you won't understand, but 746 watts represent one horse power of energy. Now, if coal costs $1.50 at the mines and labor is $1.75 per day, and—" the old man silently steals away, walks over to his lawyer's office and deeds the house and lot to his wife.

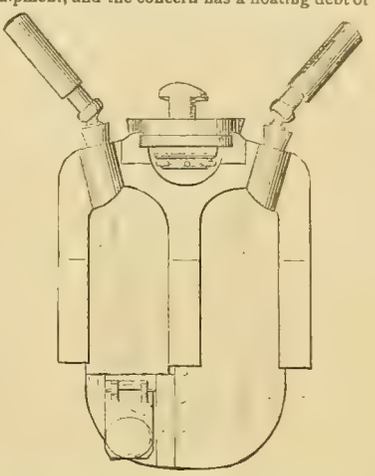


FIG. 2. THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.—BENTLEY KNIGHT SYSTEM.

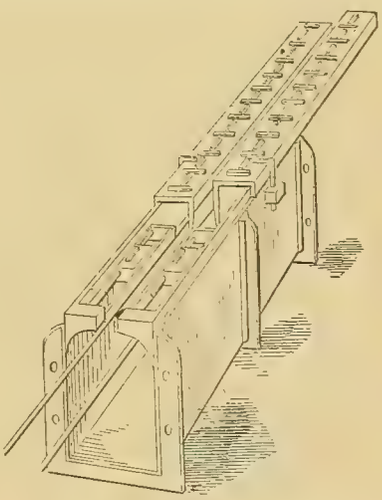


FIG. 3. THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.—LOVE CONDUIT.

This imaginary situation will find many whose relation is so closely identical, in fact, that they will secretly hug it to their hearts and call it all their own. The illustration is no more applicable to street railways than to central lighting stations. The engineer, the motorneer, the lineman, the everything—that is, the veins, the circulation of a plant may—be all right, but until we can figure and estimate and know the truth of the cost of operation and conduct of our business, there is a leak in the main artery that eventually drains

1. Read before the Northwestern Electrical Association, Milwaukee, January 18, 1894.

life away. An incandescent lamp is a beautiful thing. An arc light that does not sizzle is an eternal glory to the intelligence of men. An electric railway is a splendid thing for the public and to land improvement companies, but unless they can be maintained at a net profit before many days the fateful bottle of "crude electricity" will adorn the mantel of many humble homes.

The conductor can turn in no more nickels than he receives. The collector for a central station brings in an amount that equals the bills and no more. Electricity is not to blame if the amounts are less than the cost of the service. Somebody's head needs fixing. Is it possible that philanthropists control eighty per cent. of the electrical plants in this country? Do you know that but twenty per cent. of the lighting stations of the United States return four and one-half per cent upon investment? Then it must follow that the eighty per cent. is busily engaged in blowing bottles. Ten years ago capital lost its reputation and eagerly jumped at anything electrical. The glamor and the haze that clouded the eye of the capitalist is drifting away. Investors are inquiring after management. Is it the fault of steam that seventy-four railroads, representing a billion and a half of dollars, are in the hands of receivers? We must wake up and profit by experience that has been so dearly bought by others. It is not my purpose to weary you with figures. What I aim to do is to bring to your mind sharply and clearly the indisputable fact that we are hoping for profits in the far future, and that those hopes are based upon conjecture and guesses. It is infinitely better to do no business at all than to do a large business at a loss. We may as well be brave and look the situation squarely in the face. The public thinks we are coining money. We have the name but not the gain. We do not murmur, because the money comes from men who have other interests to protect and they bury their loss so deeply that the world can never know. Eighty per cent. of the people who grumble at the monthly bill have been given service at such a rate as to entail a loss upon the company they patronize. How long can this continue? Men who have kept steady in faith for years will falter by and by. Stock will be sold for what it will bring and the weary burden laid down. The impetus of gold mining received a deadly shock because so many claims did not pan. Electrical development must suffer if holders of stock are too often pinched.

Electricity is a quick friend, an obedient servant and an insidious power for good or evil; good if well managed, evil if guided by ignorance. If generated for less than seventeen per cent. net profit it will ruin homes and devastate the fertile field of research and progress. Electrical investigation has called out the highest talent known to the mechanical and inventive world. Let this talent be seconded by the same type of business sagacity and progress will be unrestricted, the confidence of capital will be restored, and fewer men will walk the floor far into the night, the morning sun will shine into the windows of happy and prosperous homes. The public is willing to pay living rates. That we have not charged them is no fault of it. At the same time corporations have no moral right to so conduct business that the effect of ignorance and mismanagement falls upon our necessary friend, the customer. I most earnestly trust that this paper will start a movement which looks toward the establishment of rates that will be just to the public and remunerative to corporations; that will strengthen the heart of the student, encourage research and secure the eternal friendship of the capitalist. If this be done bottles for "crude electricity" will be a drug in the market.

Essential Station Instruments.[1]

By Prof. D. C. Jackson.

The term "station instruments" may be made to cover a variety of tools and indicating devices from the coal shovel to the main fuse block. We need not discuss all the mechanical tools and will look at the electrical end first. The essential electrical instruments are such as will enable your station men to handle your dynamos and look after their regulation with the greatest precision, but with the expenditure of the least labor and with the least possibility of accident. With the usual construction, the electrical instruments are mounted collectively on a switchboard, but seldom in the best manner. Remember that accidents may involve, first, the operator; second, the plant; third, any branch of the plant.

Safety for careful operators is usually provided, but unfortunately the safety of the plant is seldom properly considered. Boiler explosions and fires are likely to involve serious destruction, and proper precautionary measures are frequently overlooked. Fortunately boiler explosions are not frequent in electric stations, but fires have been far too frequent and disastrous in their occurrence. A great many of the fires in electric stations start at the switchboard. These can be made almost absolutely safe, and, with proper construction, switchboard fires should be almost unknown. How many of you have in your stations properly constructed switchboards? And, though you have taken the usual precautions of industrial establishments against fire, how many of you pay a fairly low rate of insurance on your stations? A saving of 25 cents on your insurance rates will pay for considerable improvement in the switchboard. By making the improvements and insisting upon intelligent inspection by the insurance companies, you can gain the improved rates. At the same time you guarantee yourselves against fire.

This is better than insurance, for, however well the insurance companies may treat you after a fire, they will never repay all the losses you must incur. Build your switchboards of non-combustible material. Marble is not very expensive and is better than slate. If combustible material is used for the board, never make it solid, but arrange it simply as a skeleton upon which the instruments may be secured. Set the switchboard at least two feet (three feet is better) from the wall, and have all the wiring done in the best possible manner and in plain sight. Under the circumstances, close the ends of the space back of the board, making it into a sort of rubbish closet. Keep the space all around the board light and clean. Nothing will guarantee neat, safe wiring and safe storage of material except the entire absence from the station of dark corners and closets. There are, by the way, few station hands who will wire a switchboard in a neat and safe manner without excessive expense, unless they are carefully directed.

The switchboard should be located conveniently, and the instruments conveniently placed thereon. The dynamo instruments should be bunched together, and the different devices belonging to each individual dynamo circuit should be placed in vertical rows. This avoids the probability of the accidents to machinery which are bound to occur when the instruments are irregularly distributed. System at the switchboard is just as important to economy as is system in the accounting methods. Pressure indicators, cutting-in galvanometers, ground detectors and other instruments which are common to all the dynamos should be placed where they are easily seen by a man at the dynamo regulators. Devices placed in the feeder circuits may be placed either above or at one side of the dynamo instruments. In any case, the arrangement should be such that extensions may be readily made.

The number of instruments on the dynamo and feeder circuits should never be multiplied unnecessarily. Their type and number in any case depends upon the type of the apparatus and the purpose for which it is used. Thus, arc light plants require an arrangement which differs completely from that which is required in alternating stations, and the latter differs from that required in stations supplying a continuous current constant pressure distribution. If arc light dynamos with separate regulators or controllers are used, these should be solidly mounted near the dynamos to which they belong. In each case the maximum of safety and convenience should be sought in the choice and arrangement of the instruments. The arrangement of the standard panel switchboards of two or three prominent manfacturing companies may be followed with profit. Where two or more classes of machinery are used the different types of dynamos should be set together and the switchboards should be distinct, but side by side.

Let us drop the electrical question now and go over to the steam side. We will start with the coal bin and simply touch upon the instruments or tools not generally used, but which can usually be advantageously added to the equipment, that is, which are likely to add to the dividend-paying capacity of the station. The first instrument on this list is a platform scales for weighing in the coal. Daily records of coal consumed should be carefully kept and compared with records of the electrical output, day by day, week by week, and month by month. Complete daily records enable a station manager to determine whether he is getting the greatest results with the least expense, as he can determine the question in no other way. The coal records also enable a direct comparison of the economy of the different grades of coal. Many station managers give too little attention to this matter, simply purchasing the grade of coal which happens to have the lowest price per ton. This is frequently all right, but sometimes it is not economical.

The coal shovel is an essential instrument (a very essential one), which requires a great deal of careful supervision. The coal records and automatic records of steam pressure serve this purpose. An automatic steam pressure recorder is not an expensive instrument. If one is properly installed and its indications are acted upon by the manager, it will soon save its cost. There are various automatic recorders. A first-rate one is the Bristol. The Edson, which is more expensive, has some advantages, which are, however, of little moment in a small plant. Those of you who have operated stations, both where pressure recorders are and are not used, will doubtless be ready to bear witness to their advantages. Thermometers in the feed water pipe and in the steam pipe are not essential to the operation of a station, but they are certainly advantageous. A throttling calorimeter made of ordinary fittings is also serviceable. The use of the thermometers and calorimeter may look to you like kid-glove engineering, but if you are anxious to get the best result from your steam plant for the least cost, you will use them. They are not kid-glove affairs, but good common-sense appliances. Steam gauges on the boilers (good, reliable ones), all will agree, are essential, but it is not usual to put one in the steam pipe near the engine. It is a good idea, however. I am acquainted with a plant of considerable size which operates 24 hours in the day. During the daylight the load on the plant is small and the day engine races badly because it is underloaded when the steam pressure is held to its usual 100 pounds. In such cases it is the impulse of the average fireman and engineman to throttle the steam by partially closing the boiler valve. In the station I speak of the reduction in the pressure is 20 pounds. Let us see the result. In first bringing the boiler pressure up to 100 pounds above the atmosphere a certain amount of heat is furnished to the steam from the fuel. Where the pressure is reduced by throttling the steam is cooled to a lower temperature and some of the heat contained in the high pressure steam is lost. This loss means an equal decrease in the power of the steam, and, therefore the coal which was used in raising the pressure from the low value to the high one is simply thrown away. When it is necessary on account of light day loads it is much more economical to lower the boiler pressure to a satisfactory figure. In the station referred to the loss in fuel on account of throttling was from 5 to 10 per cent. Five to ten per cent. of the fuel used on day load makes a considerable item in the period of a year, which will pay for the recording boiler gauge and a gauge in the engine pipe, besides adding a sum to the dividend account. It is true that the gauge in the engine pipe does not remove the fireman's impulse to reduce pressure by throttling, but if his work is constantly under inspection, the impulse is much less likely to be irresistible. In this connection let me remark regarding the usual practice of cutting off the condenser at times of light load when condensing engines are used. Under such circumstances, fuel is saved by keeping the condensers running, but reducing the boiler pressure to hold the engine cut-off at an economical point.

Another instrument of much use is the engine indicator. This is particularly useful in determining whether the engines are working at their most economical cut-off and whether the valves are properly set. A great many engineers keep fooling with their engine valves, and rely upon their eye and ear to set them properly. This is generally poor economy, and the indicators should be brought into requisition. If cards are taken at fixed intervals and filed for reference, they may be made a decided aid in the effort to keep everything at the most economical point. In the valve setting alone, if the indicator can point out the way of saving a very small per cent. of fuel, it will quickly pay for itself in this country of expensive coal. The horse power calculated from the diagrams, compared with water and fuel records, and again with electrical records, give all the elements necessary for determining at any time whether the plant is doing its duty satisfactorily.

I have spoken particularly of instruments that are frequently not used in the stations, but which can be made of much valuable assistance in reducing expenses. These are not varnished theoretical ideas, but hard, common-sense, dividend-earning suggestions. They can be put into service without increasing the operating costs in any way, and the instruments will ordinarily quickly pay for themselves. What I have said is probably not new to any of you, but there are some old ideas, the reassertion of which it pays to listen to and discuss.

1. Read at the convention of the Northwestern Electrical association, January 17, 1894.

Influence of Electricity on Vegetation.

The extent to which electricity can be made to affect the growth of plants has been an interesting field of investigation to scientists for a century and a half. Various results have been obtained, and there is no doubt that the time is coming when the world will be in possession of exact information on this subject, such as can be turned to account. Meanwhile every contribution is welcome. One of the late experimenters is Prof. C. D. Warner, of the Massachusetts State Agricultural College, who describes the method employed as follows:

For purpose of comparison, two plots of ground were prepared, side by side, each 6 by 20 feet, one to be used with, the other without, electricity. In this paper these plots will be designated as the electric and non-electric gardens. The soil was a rich loam, well spaded, and the plots so situated that the rows of the non-electric were the continuation of those of the electric garden, with a space of about twenty inches lying between the two. Around the electric bed, or garden, was constructed a framework made of 2 by 4 inch timbers, on which were fastened porcelain insulators, four inches apart; a continuous, non-insulated copper wire (No. 15) was strung on these porcelain insulators, and the whole structure was then buried so that the wire should be two inches below the surface of the ground. Near at hand was a transformer, a small house in which were placed switches, meters, voltmeter, ammeter, reducer and resistance lamps. When the apparatus was put in place, perfect control of the currents was obtained throughout the whole time the experiment was in progress. Electricity was generated by the dynamo at the electric light station; the current was alternating and was applied nightly from time of turning off the current at the generating house until after 11 o'clock, or about four hours daily, from June 10th to October 1st, inclusive.

From June 10th, the beginning of the experiments, to July 13th, the current was steadily increased from twelve amperes to thirty-nine amperes, which was the maximum reached, and it remained at this point from July 13th to September 30th. The voltage varied from fifteen as a minimum to fifty-three as a maximum.

The ground having been prepared, was planted on June 8th with seeds of ten varieties of vegetables, sown in drills midway between the wires; no fertilizer whatever was used, and if there was any difference in the fertility of the soil, it was in the favor of the non-electric plot. Throughout the period of investigation and study both plots were subjected to identical treatment, save in the application of the electric current. Electricity was first applied June 10th, the current being twelve amperes, as it was thought proper to use a small quantity at the start, that the effect of the stronger current might be more intelligently studied as the experiment proceeded. Throughout the period the ground was kept well watered, in order that it might act as a good conductor.

Prof. Warner then gives a full history of the development of the vegetables, drawing the following conclusions:

(a) That when subjected to electrical influences some varieties of seeds germinate more quickly and certain plants blossom sooner.

(b) That some kinds of vegetables have a tendency to enlarge their roots, while others grow a large amount of tops.

(c) That plants standing near the electrodes devolop a larger growth of roots and foliage.

(d) That tomatoes ripen sooner.

(e) That the vegetables experimented with were not at all injured by a current of 39 amperes, with a voltage of 53, but rather were stimulated in growth.

He adds that growing vegetables by electricity can hardly be considered practical. Experiments with tall poles, crowned with teeth, for collecting the electricity of

the atmosphere, or where copper and zinc plates buried beneath the plants were used, cost very little as compared with the expense of growing plants with the aid of electric currents generated by batteries or dynamos. The method of collecting and using atmospheric electricity might be employed with a possibility of the farmer being well paid by an increased growth of cereals and some varieties of vegetables; but when batteries and dynamos are employed, the cost of the instruments, wires, increased amount of labor, resulting from a network of lines, in addition to the expense of generating the electricity used, would render the undertaking too expensive for the everyday farmer. The increase in crops would scarcely pay for the trouble and outlay; but, be this as it may, it is very apparent that electricity does to a certain degree influence the growth and development of plants. What the results of the foregoing experiments would have been had the plants, during their growth, been subjected to continuous electrical influences, cannot be foretold.

Applications for Injunctions.

A special despatch from New York announces that the General Electric company has applied for injunctions in four cases against the F. P. Little Construction company, Buffalo, before Judge Coxe of the United States Circuit Court at Albany. The first case involves compound winding of dynamos, the second Johnson's patent for double safety catches, the third Stieringer's patent for safety catches, and the fourth coupling of dynamos. This proceeding is looked upon as an indication of the policy of the General Electric company to force constructing companies to purchase its apparatus. Such a course will be bitterly contested, and will open up an almost endless field of litigation.

At Albany last week two applications of the General Electric company for injunctions against E. G. Bernard & Co. of Troy on the three-wire and compound wiring patents were denied. The trial of the feeder and main case was completed, but the decision was reserved.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 22.—In the due course of time the rapid transit commission has virtually thrown aside the overhead plan of rapid transit, and is now actively engaged in discussing an underground electric system again. Last week the commission received a proposition from R. T. Wilson, a prominent banker, who represents a syndicate. Mr. Wilson said:

As a guarantee of our good faith in the matter we propose to deposit $1,000,000 in good securities, to be approved by you, in a first-class trust company in this city on the condition that the same shall be forfeited to the people of New York in the event that we shall fail to sign the contract for the construction of such road when the execution thereof shall be authorized by the vote of the people of this city. We propose to build that portion of the route between the city hall and Fourteenth street within two years from the time of the signing of the contract; the portion south of the city hall and the portion between Fourteenth and Fifty-ninth streets on the West Side and Fourteenth street and Forty-second street on the East Side within three years from the time of the signing of the contract, and the portion between Fifty-ninth street and Fort George, and between Forty-second street and Harlem within four years from the time of the signing of the contract. So soon as the completed system herein above provided for shall pay 4 per cent. on its cost, over and above its operating expenses and other expenses, we will build an additional mile on each side of the city, and so soon as each additional mile pays a like 4 per cent. upon its cost, etc., we will build another mile, until the terms provided by you are reached. We think also that some arrangement should be made by which your board should have power to grant extensions of the railway in other directions, if you should deem it for the interest of the public.

The general plan of construction we shall ask you to change somewhat, permitting the building of a double-decked tunnel instead of four tracks on one level, as we feel on the report of our engineers that it can be thus done more cheaply and with less chance of injury to private owners. The method of construction will be substantially the same as that provided for in your proposed terms of sale of the underground railway; that is, tunneling to be done from beneath the surface and the structure to be located sufficiently far below the surface to avoid all existing pipes, but the method of construction may be departed from with your consent in special localities where engineering difficulties make it necessary so to do.

The motive power to be the same as that provided in your report to the common council of October 20, 1891, viz., electricity of some other power not requiring combustion within the tunnel, and the motors to be capable of a uniform speed for long distances of not less than forty miles an hour, exclusive of stops.

We wrote to you one year ago offering to build such road, if the city would loan 70 per cent. of the cost, but were met with the provision of the constitution forbidding such a loan. Since that time we have been carefully considering the matter with associates willing to embark in the enterprise, and we have reluctantly reached the conclusion that it is not within the limit of private means to raise the entire sum necessary to build this system. We are willing, however, to resume the responsibility of expending one-third of the entire cost if the city will loan us its bonds to the extent of two-thirds of the cost, and we are advised that inasmuch as a constitutional convention for the purpose of revising the constitution of the state of New York is to meet this coming summer, the present provision of the constitution forbidding such loan could by a proper amendment be removed in this special case.

Under no circumstances shall the loan to be made by the city exceed $30,000,000. If the cost of the road shall run above $45,000,000, all the balance shall be borne by the constructing company. The city shall under no circumstances be asked to make any loan upon the extensions above Fort George and Harlem.

All the commissioners express themselves as being in favor of an underground electric road, and now that a proposition has been made in some definite form they are willing to abandon Mr. Bushe's scheme for an elevated system. The commission will meet to-morrow and take action upon Mr. Wilson's offer.

President Daniel F. Lewis, of the Brooklyn City Railroad company, has made a detailed statement of the negotiations resulting in the consolidation of the Broadway and associate lines with the Brooklyn City & Long Island Traction company. The Broadway and associate lines will be known in the new system as the Brooklyn, Queens County and Suburban railway. They cover 106 miles of track, existing and to be constructed, and extend as far as Jamaica. The company is capitalized at $10,000,000. The consolidation scheme received the unanimous approval of the directors of the Brooklyn City & Long Island Traction company.

A motion for the appointment of a temporary receiver of the property of the Thomson- Houston Electric company, of New York, was made on January 18th to Judge Barrett in the Supreme Court chambers at the instance of Henry R. Worthington, a judgment creditor of the company, for $1,576.53. In reply to the motion it was alleged on behalf of the company that it was unable to pay the amount of the judgment. There is also a judgment, it is claimed, against the company for $75,279.50 in favor of the Durant Land Improvement company for rent. It was feared that the appointment of a receiver would more seriously embarrass the company and depreciate the value of its stock and property. It was therefore asked that with the appointment of a receiver the court grant an injunction restraining all creditors from taking any proceedings against the company or interfering with its property. W. F. O.

New England News.

BOSTON, January 22.—A bill was introduced into the lower house of the Massachusetts Legislature January 10th, which is virtually the beginning of a repetition of the struggle on the question of placing existing overhead wires underground which was so bitterly fought last year. Perhaps nowhere has the proposition to order down the wires aroused so much feeling as it has here, and it is evident that much opposition will be encountered in the effort to pass the bill. There are many interesting features in the bill, which not only provides for the removal of all overhead wires with the exception of the trolley but authorizes the construction of conduits in all cities and towns in Massachusetts where they are desired at the expense of the municipalities. The proposition is inclined in the bill that the companies and individuals now maintaining overhead wires and cables be required to place them in the conduits built by the city or town and remove their overhead construction in all streets provided with conduits, and that the companies and individuals shall pay to the city or town government such amounts as will insure not less than 10 per cent. upon the amount invested in the conduits.

Representative Hathaway of Brockton has filed with the clerk of the house a bill to enable cities and towns to manufacture and distribute gas and electricity for municipal purposes. The act provides that any city or town in the commonwealth may construct and maintain within its limits one or more gas and electric plants, and may also furnish the product to adjoining cities and towns at prices to be fixed by city councils, boards of selectmen or gas commissioners of such cities and towns. No plant is to be established unless by consent of a majority of a city council, the vote to be ratified by vote of the people. In towns there must be a two-thirds vote of the people. It is further provided that bonds may be issued in payment of such plants, to run not more than 30 years, and to bear interest at not more than 5 per cent., the amount of such bonds not to be included in the limit of city or town's indebtedness, and cost of plant is not to exceed 5 per cent. of the entire valuation of towns and 2½ per cent. of the valuation of cities. Use is permitted of poles of existing companies as compensation, but no damages are to be paid to existing companies on account of loss by competition by municipal plants.

Since the destruction of the power house of the Interstate railroad by fire negotiations have been pending with the Pawtucket Gas company for power, in order to run the cars. Mr. Sweetland, the receiver of the road, has been in consultation with the officials of the Pawtucket Gas company, and has been informed that the company can supply him with all the power he requires. More than that, there is no dispute between them as to the price to be paid. The Pawtucket Gas company has 350 horse power boiler capacity at the old station, in rear of North Main street, which is now unused, and a portion of which can be utilized at once and the remainder in a few days. As the Inter state company wants only 250 horse power, it will probably secure its power in this way. S. P. D.

PERSONAL.

C. Robinson, designing engineer of the power and mining department of the General Electric company, was in Chicago last week.

W. H. Preece, engineer-in-chief of the British Postoffice Department and who has a wide acquaintance in the United States, has been honored by Queen Victoria by appointment as a knight commander of the Bath.

John Macwatty, formerly general sales agent of the Campbell's Hair Belting company, has been appointed manager of the sales department for New York city by the Eastern Rubber Manufacturing company, of Trenton, N. J.

One of the most popular young men connected with the Chicago office of the General Electric company is Jesse Scribner, and his friends are just now felicitating him upon his marriage with Miss Agnes L. Higgins, of Wakefield, Mass., which took place at the residence of the bride's parents on January 9th. Mr. Scribner's office associates testified their appreciation by several handsome wedding gifts.

NEW INCORPORATIONS.

United States Headlight company, Utica, N. Y.; capital stock, $1,500,000; to manufacture and sell electric and other locomotive headlights; Irving A. Williams, Utica, N. Y.

Williams General Manufacturing company, St. Paul, Minn.; capital stock, $10,000,000; to build motors and the Dent telegraph typewriter; D. H. Dent, St. Paul Park, St. Paul, Minn.

Belleville Electric Railway company, Belleville, Ill.; capital stock, $300,000; to construct an electric railway from the eastern limits of Belleville to the western limits of East St. Louis.

ELECTRIC LIGHTING.

G. E. Claflin, of Kansas City, has gained an electric light franchise at Perry, Oklahoma.

The Co-operative Electric Light company, Chicago, has certified to an increase in capital stock to $1,000,000 and of directors to seven.

A central station is to be established at Lugo, in Galicia, Spain. The plant will comprise two turbines, each of 50 horse power and two alternating current dynamos.

The Millvale, Pa., council met on January 9th and decided to change the plans of the electric light plant. The present 40 light dynamo will be replaced by one of 60-lights capacity, and new lamps will be placed on the poles. The change will require an outlay of $860.

Much discontent is manifested at Passaic, N. J., over the action of the local electric light company, which has advanced the charges for incandescent electric light service 10 per cent. The rate for commercial arc lights was increased from $5 per lamp per month to $9.

The city council of Mankato, Minn., was called together on January 13th to discuss the electric light question. Lights were all turned off in the evening to force the payment of two months' bills of over $1,000 due the company by the city. A few weeks ago a Minneapolis electrician was called to investigate the strength of the lights. He reported the power not up to the contract. The mayor refused to sign the company's bills after that time. Notice was served on the mayor to pay or get no more light. The mayor declined to recede from his former position.

ELECTRIC RAILWAYS.

An electric railway is to be opened between Bordeaux and Bouseat, France.

The city council of Portsmouth, O., has turned the city lighting contract over to the street railway company.

Siemens & Halske propose to establish an electric tramway between Wiesbaden and Kastel, Germany.

C. E. Moss and Robert Gillam have secured consents for proposed extension of the "L" electric road at Kansas City, Mo.

An effort has been made by the citizens of Lake View, Chicago, to secure an extension of the North Side cable system. This the management has refused to do, but offers under certain considerations to construct a trolley line to

meet the present terminus of the cable road. Although there seems to be some opposition to an electric line, there is a good prospect that it will be built.

It is contemplated to change the existing East End dummy line at Memphis, Tenn., into an electric line in the spring.

The Columbus, O., & Clintonville Electric Railway company and the Worthington lines are said to be about to consolidate.

W. J. Brodrick has gained a franchise for a cross-town electric line in Los Angeles, Cal., which will be immediately prosecuted.

The citizens of Sanborn, N. Y., have raised money to procure the extension of the Buffalo & Tonawanda electric railway to Sanborn.

The electric railway in Villa Borghese, Rome, has been opened by Captain Cattori, the manager. The system is on the underground conduit plan.

It is understood that arrangements have been made to change the motive power on the street railway system in Leavenworth, Kan., to electricity.

The Main street and the Main and Preston street lines of the Louisville, Ky., Railway company were electrically operated for the first time January 21st.

General Manager J. F. Porter, of the Alton, Ill., electric railway, is making estimates for a North Alton line, and says it will be built early in the spring.

Extended improvements are to be made upon the Central electric system, Sacramento, Cal. An extended service will be in operation by February 1st.

The city railway company of Dayton, O., asks stockholders to vote on a proposition for $600,000 6 per cent. bonds, which sum is to be used in equipping it with electricity.

Preparations are being made to build a railroad bridge across the Illinois river near Peoria, Ill. It is said that it will be used to accommodate the new Peoria and Pekin electric railway line.

It is stated that a syndicate has been formed in Cologne, Germany, to construct an elevated railway on a new system. Messrs. Schuckert & Co., Nuremberg, are interested in the scheme.

L. O. Ives and Wm. Ottman, of Chicago, who have gained a franchise for an electric railway recently in St. Joseph, Mich., are pushing plans for the road and real estate investment.

A franchise has been granted to W. W. Kendall and Theodore S. Case, by the Westport, Mo., city council for an electric line to connect the cable and the suburb line. Hugh T. McElroy and Preston Roberts are directors, and the grant is for twenty years.

It is reported that the General Electric company, of Portland, Ore., is about to build new lines and extend old ones, until a continuous electric road is finished via Oregon City to Astoria. Water power is to be used, and freight is to be carried principally. It is said that the Southern Pacific company is back of the scheme.

France is taking several forward steps in electric traction. The town of Dijon has given a concession for its electric tramways to a contractor of Lyons. The municipality of Grasse has been asked for an electric railway franchise by M. Leveque. Mouveaux will have a trolley line on an American franchise basis.

MISCELLANEOUS.

City Electrician Cabot of Cincinnati, O., has found that there are 800 miles of electric wire strung over the city without permits, of which a large part is railroad wire. The B. & O. S. W. Railroad company owns 200 miles of it. Steps are being taken to prosecute the offenders.

Harbormaster Skeldon of Toledo, O., is considering the proposition of operating all swing bridges in the city by means of electricity. He has received figures of the probable cost, and says that the cost of an electric plant to operate the swing of the Cherry street bridge would be from $1,000 to $1,200. The electric light and power companies offer to supply power sufficient to run the motors at $25 per month. The cost at present to maintain the bridge and operate the engines is nearly $100 per month for coal, and about $90 per month for firemen. It is quite likely that the bridge committee will consider the problem at the next meeting.

TRADE NEWS.

The Capitol Model & Machine Works, 83–87 Fifth avenue, Chicago, model makers and dealers in general electrical supplies, report a brisk business since opening their offices several months ago.

"The pen is mightier than the sword." So say Cushing & Morse, western agents for Kerite, who are sending to the trade an aluminum quill, begging it to "be sure to specify Kerite." Kerite has been on the market for nearly thirty years, and Cushing & Morse claim it is better than ever.

The annual meeting of the stockholders of the Swan Lamp Manufacturing company was held at Cleveland on January 16th. The following named officers and directors were elected: President and general manager, S. M. Hamill; vice-president and treasurer, B. F. Miles; secretary and superintendent, S. E. Cox; electrician, R. P. Roberts; directors, W. H. Lawrence, B. F. Miles, L. H. Rogers, Webb C. Hayes and S. M. Hamill.

The Manhattan Electrical Supply company, 36 Cortlandt street, New York, is sending to the trade a communication quoting prices on telephone receivers. The letter also embodies a warning against the use of certain apparatus, containing points which are broadly covered by patents controlled by the Bell company.

William H. McKinlock, president of the Metropolitan Electric company, Chicago, has been called to New York to close a contract for a full line of specialties. The company is now installed in its commodious store and wareroooms, 186 and 188 Fifth avenue, where it has ample room for the display of specialties and is in a position to take care of its growing business.

About a year ago the Joseph Dixon Crucible company, of Jersey City, N. J., issued a pamphlet on lubricating graphite. It embodied an elaborate scientific opinion by Prof. R. H. Thurston on the value of graphite as a lubricant, and much interesting information on the subject from practical men. The pamphlet has had a large circulation, and the company has been enabled to obtain from well-known men a vast amount of additional knowledge on the uses of graphite. Another pamphlet, twice the size of the former, will be issued early in February, and a copy will be sent to all interested in the subject of friction and lubrication.

The Electric Appliance company, Chicago, has recently added several improvements to its Washington alternating arc lamp, which make the lamp even more desirable than it was as originally placed on the market. A highly polished metal reflector has been placed over the outside of the globe which can be used or not as desired. The metal base of the lamp has been done away with entirely, leaving nothing whatever on the lower part of the globe to obstruct the light and also shortening the lamp several inches so that a 15 hour lamp is now only a trifle over 20 inches long over all.

BUSINESS.

C. M. Turnquist, Lakeside building, Chicago, reports doing a very good business in electrical supplies since the first of the year.

Huebel & Manger of Brooklyn have been busy of late in filling their orders for improved pivoted bells and have enlarged their factory by taking additional room, increasing their manufacturing capacity. This firm will make a specialty of small electric house bells.

The electrical supply house of Julius Andrae, Milwaukee, Wis., was destroyed by fire January 13th; the damage to the stock and building will amount to $10,000 at least. Temporary quarters were secured immediately, one door from the old location, and business will be attended to as heretofore. A full stock of specialties is now on the way. The fire was caused by an overheated furnace.

The Metropolitan Electric company, Chicago, has completed the work of removal to its new store and warerooms, 186 and 188 Fifth avenue. The company will now have more direct supervision over its affairs, with the additional advantage of increased space which will permit it to carry larger stocks of staple articles and exhibit its specialties, insuring its customers more prompt attention than it has been able thus far to give.

The Connecticut Royal Arc company, Hartford, Conn., has met with considerable success with its spark arrester. This device has been indorsed by the Underwriters' International Electric association of Boston, the inspection department of the Boston Board of Fire Underwriters and the New England Insurance Exchange of Boston. The device is the same that has been recently adopted by the Hartford Electric Light company, and is being placed on the street lamps. It is simple, but it is claimed that in its operation it does away entirely with the danger from falling sparks.

The Wallace Electric company, with offices at 104 Michigan avenue, Chicago, has been organized for the purpose of conducting a business in electrical goods as manufacturers and manufacturers' agents. The company's line embraces alternating current generators, motors, meters, transformers, wires and cables for all electrical purposes, incandescent and arc lamps, measuring and indicating instruments, switches, a full line of electrical street railway appliances and supplies, and a few carefully selected specialties. The officers of the company are: President, William S. Hine; general manager, J. B. Wallace; secretary, Max A. Berg. M. M. Wood will be the electrical engineer of the street railway construction department. The Wallace Electric company enters the electrical field thoroughly equipped to promptly handle all orders, and is in a position to become an important factor in the business.

ELECTRICAL PATENTS.

Issued January 9, 1894.

512,320. Electric Incandescent Lamp. John Peil and Carl K. MacFadden, Chicago, Ill.

512,327. Electrically Propelled Vehicle. James H. Rogers and Willard Fracker, Washington, D. C.

512,331. Electric Cut-out. Albert P. Seymour, Syracuse, N. Y.

512,340. Coil for Electro-magnets. Nikola Tesla, New York, N. Y.

The coil is constructed on the principle that in every coil there exists a certain relation between its self-induction and capacity that permits a current of given frequency and potential to pass through it with no other opposition than that of ohmic resistance, the self-induction of such a coil for the given frequency being neutralized by the capacity of the coil. The adjacent convolutions of the coil form parts of the circuit between which there exists a potential difference sufficient to secure in the coil a capacity capable of neutralizing its self-induction.

512,373. Trolley Cut-out. Melancthon Hanford, Malden, Mass.

512,386. Electro-magnet. Frank R. McBerty, Chicago, Ill.

512,395. Producing Illuminated Letters. James H. Rogers, Washington, D. C.

512,397. Spark Regulator for Dynamo electric Machines. Charles E. Scribner, Chicago, Ill.

The invention relates to a method of regulating a dynamo to prevent spark by changing the strength of the field of force of the short-circuited coils when the strength of the main current is changed to maintain a constant relation between the current which is built up in the short-circuited coils and the current which is present in the current-producing coils into circuit with which the short-circuited coils are introduced.

512,398. Apparatus for Telephone Switchboards. Charles E Scribner, Chicago, Ill.

512,399. Apparatus for Telephone Switchboards. Charles E. Scribner, Chicago, Ill.

The operating coils of the different annunciators are connected with the signaling circuit of the telephone line, while the restoring coils are arranged in local circuits adapted to be closed incidentally in the operation of the ringing key by which the operator sends a calling signal to the called subscriber.

512,400. American District Electric Signal Apparatus. Charles E. Scribner, Chicago, Ill.

512,401. Duplex Arc Lamp. Charles E. Scribner, Chicago, Ill.

Two lamps provided with separate and independent regulating mechanisms are connected, one in a normally open and the other in a normally closed branch circuit between two supply mains, mechanism being provided in the lamp situated in the normally open circuit which operates to close that circuit to form the arc between the carbons included in the circuit and to regulate the arc when the resistance of the arc in the first lamp is slightly increased.

512,413. Telephone Call Recorder. William B. Thompson, Chicago, Ill.

512,422. Printing Telegraph. Emil A. Wirsching, New York, N. Y.

512,424. Alternating Current Dynamo. James J. Wood, Fort Wayne, Ind.

512,425. Connection Between Separately Excited Dynamos and Their Exciters. James J. Wood, Fort Wayne, Ind.

The dynamo and the exciter are mounted upon independent bases which are rigidly secured together, so that the base of the exciter follows the movement of the base of the dynamo. The exciter is adjustably mounted upon its base, so that it may be moved relatively to the dynamo to tighten the exciter belt.

512,444. Closed Conduit Railway. Charles J. Kintner, New York, N. Y.

512,448. Socket for Incandescent Lamps. Thomas L. Pfarr, Pittsburg, Pa.

512,454. Time Indicator Attachment for Telephones. Charles Stever, San Jose, Cal.

512,464. Incandescent Lamp. Augustus C. Carey, Lake Pleasant, Mass.

512,473. Secondary Battery. Frank K. Irving, New York, N. Y.

512,481. Electric Arc Lamp. Regina Niewerth, Berlin, Germany.

The lamp comprises a series of electrodes arranged around a common center and adapted to be rotated on their axes, a commutator and brushes being provided for supplying the electric current and imparting alternate polarities to the electrodes.

512,482. Electric Arc Lamp. Regina Niewerth, Berlin, Germany.

512,510. Depolarizer for Voltaic Cells. Gardner Hewett, New York, N. Y.

The depolarizing material comprises nitric acid, sulphuric acid and bichromate of sodium in the form of a dry powder.

512,514. Electrode for Secondary Batteries. William Morrison, Des Moines, Ia.

512,535. Electric Railway Current Collector. Eben M. Boynton, West Newbury, Mass.

512,567. Battery. Wilbur M. Stine, Athens, O.

The storage battery is provided with an alkaline electrolyte formed of a mixture of sodium hydrate, sodium zinccate, sodium chloride and sodium chlorate, forming an aqueous solution.

512,603. Electrical Transformer or Converter. Charles L. Coffin, Detroit, Mich.

512,604. Apparatus for Electrically Welding Metal. Charles L. Coffin, Detroit, Mich.

The apparatus comprises a clamp for holding the material in position to form a lap-joint, and mechanism for maintaining a voltaic arc on the outer side of the outer lap, and mechanism for simultaneously maintaining a voltaic arc on the inner side of the inner lap, within the field of force of a magnet.

512,612. Device for Blowing Out Sparks on Commutators of Dynamos. Hamilton W. Hanahan, Winnsborough, S. C.

512,614. Electric Switch. Jesse L. Hinds, Syracuse, N. Y.

512,637. Incandescent Electric Lamp. Joseph W. Turnbull, Pascagoula, Miss.

512,656. Relay. Fred M. Locke, Victor, N. Y.

512,667. Double Carbon Arc Lamp. Charles E. Scribner, Chicago, Ill.

512,672. Fire Alarm Attachment. Charles E. Egan, Chicago, Ill.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, FEBRUARY 3, 1894. No. 5

Three-Phase Distribution at Concord.

The attention of electricians all over the country has been directed to the new electric plant of the Concord Land & Water Power company, not on account of its size particularly, although it is one of the largest water power plants in the country, but principally because it is the first plant in the world using induction motors and the triphase current for general distribution.

The proposed plan was published over a year ago in the WESTERN ELECTRICIAN, and has been completed as then described.

A new dam 497 feet long has been built across the Merrimac river at Sewalls Falls about five miles from Concord. The details of construction of the dam are shown in the view at the right in Fig. 1, while the inside of the headgates is illustrated in the central view. The arrangement of the wheels and penstocks can be understood at a glance by reference to the view at the left. As a whole the plant is considered a model of its kind, and its operation will be watched with no little interest. It will furnish 8,000 horse power, 2,000 of which will be used in the new power house, which is 45 by 160 feet. This power house contains eight horizontal turbine wheels of 200 horse power each arranged in pairs, as shown in Fig. 2, and belted to a counter-shaft, as shown in Fig. 3. The details of this shaft are shown in Fig. 4. The one now in place is made up of five sections connected by four Hill clutches of 400 horse power each. The pulleys on this shaft are built on quills so that by disengaging them with the lever the entire pulley may be stopped while the shaft is permitted to turn freely through it. Every bearing in the station—wheels, shafting, dynamos and pulleys—is provided with lubricating rings, thus reducing friction to a minimum. The disposition of the wheels along the line of shaft avoids the risk of any serious breakdown.

The initial installation will be seven 50 lamp direct current arc and two 250 kilowatt three-phase generators. From the latter is now taken current for motors, incandescent and arc lights and for heating and everything where the ordinary alternating current is used. The motors, which have been running since September, give entire satisfaction.

FIG. 1. THREE-PHASE DISTRIBUTION AT CONCORD.

The entire plant was proposed, designed and executed by Eugene F. Carpenter, superintendent of the company.

The Telephone Situation.

It is reported from Boston that the American Bell Telephone company has petitioned the Legislature for permission to increase its capital stock about $30,000,000. The present stock represents $20,000,000, and the company desires to make it $50,000,000, ostensibly for the purpose of extending and improving the service. It is asserted that the increase of the stock is for a triple purpose—the extension of the long distance service, the absorption of a number of subordinate and extra-territorial companies and for extension, improvements and general changes.

Despite the apparent confidence of the Bell people in the business prospects of the future, the latest report of the company indicates an outlook that must be far from satisfactory. For the month ending January 26th the gross output of the Bell Telephone company was 4,453 instruments, against 7,121 for the same month in 1893, a decrease of 2,668. The number of instruments returned was 6,688, against 4,896 for the corresponding month of 1893, an increase of 1,792. This makes the number returned for the month exceed the gross output by 2,235, against a surplus in the output of 2 225 in 1893—a gross decrease of 4,460 instruments.

Reports from Philadelphia are to the effect that a wealthy syndicate has been formed there, known as the Clamond Telephone company, to operate a system of telephones throughout the United States. The system to be used is now in use in Berlin and London, and is also used by the French government in all public departments. Among those said to be interested are the Pennsylvania railroad officials and friends of the Philadelphia Traction company.

The receiver patent of the American Bell Telephone company expired on Tuesday.

In an article on the telephone situation the *New York Tribune* very truly says:

No new company ever entered the contest for popular favor with a more generous reception than that which the public will accord to new schemes of the telephone. The high charges of the existing companies alone assure a welcome to competition. The charges are universally recognized as far beyond a reasonable return on capital which is not

supported by close patents. The telephone has become as necessery to modern business as are the telegraph, the cable and the railroad. The big dividends paid by the Bell company are evidence of the immense profits wrung from the business world, and no one except the friends of the monopoly pretends that its charges are not far in excess of the cost of maintenance and of interest on the plant. Only because the Bell patents have heretofore held competition bound hands and feet, has the company been able to exact such high rates for its service.

Economic Use of Transformers.[1]

By W. Forman Collins.

In the distribution of electrical energy by means of alternating currents the transformer may be considered to be the key to the situation, because by its use we are enabled to so change the form of the energy as regards its

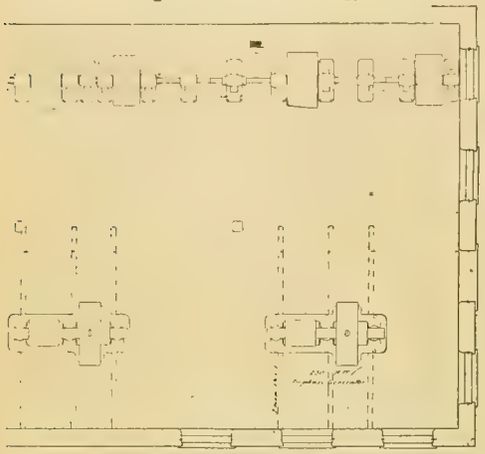


FIG. 2. THREE-PHASE DISTRIBUTION AT CONCORD.

electromotive force and current as to render it suitable for the operation of all kinds of translating devices and transmit it from point to point cheaply and with small loss. It accomplishes all this for us without any rotating or moving parts, which is its most important feature of value. In fact, a transformer performs a function for the energy of an alternating current that may be closely likened to that which electricity does in enabling mechanical energy, primarily, to be carried from place to place by a perfectly inert conductor without the employment of moving parts, such as belts, shafts or wire ropes. Having such a device, it is evident that it is a most important point to utilize it as economically as possible in any work which we may desire to do by making the device itself as efficient as we can in the first place and then by so distributing and arranging these devices that the best results may be obtained, and absolute certainty of good and continued service with minimum loss and expense be assured.

By considering the several features of transformers and studying the way in which they operate, we can arrive at the right way to secure the greatest economy in their use. Perhaps the best way to do this is to look at the problem as follows: The actions that go on in a transformer, the losses that occur, the methods of construction and distribution.

ACTIONS.

A transformer is, to all intents and purposes, similar to a dynamo which has no rotating armature, but in which, instead, the magnetic lines of force are caused to alternate rapidly by connection to a source of alternating current; an electromotive force is produced in the primary coil by the alternating source varying the magnetic lines that link through the coil, these in turn pass through the secondary coil, which is in inductive relation to the primary and produced an electromotive force in it also, because the two coils are connected magnetically by being wound about the same iron core. The rate at which the

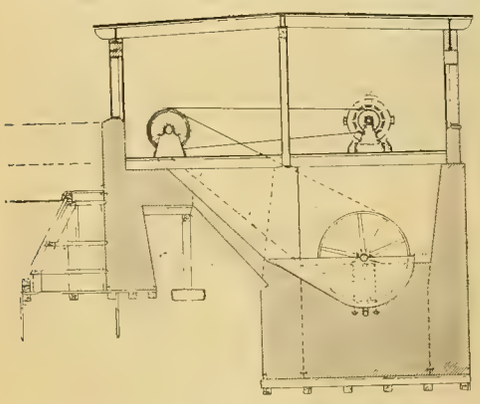


FIG. 3. THREE-PHASE DISTRIBUTION AT CONCORD.

magnetic lines due to the primary current are cut by the secondary coil represents a measure of the electromotive force given to the secondary. The magnetizations produced in the primary and secondary coils are proportional to their ampere turns, and will, of course, oppose one another, thus lowering the actual magnetism produced in the iron core; the lines of force threading both coils, are the resultant effect of the two forces.

The voltage produced at the terminals of the secondary coil depends simply upon the ratio of number of turns of the wire in each coil, provided the induction is the same through both. If the length of wire in the two coils is the same the electromotive forces would be the same, and if the length of the primary is twenty times that of the secondary they will be as 20 to 1; for instance, at the quite usual pressure of 1,000 volts on the primary the secondary would be 50.

A transformer on an alternating circuit possesses inherently a property of inductive resistance or impedance which is similar in its action and effects to the back electromotive force of an ordinary motor which only allows the absorption of a very small current when there is no work being done by the motor, this small current being sufficient to rotate the armature and overcome the frictional and other losses. The inductive resistance of the primary acts in the same way, opposing the pressure on it and almost balancing it in a well designed transformer so that but a small current is absorbed in the primary when there is no work being done by the secondary in supplying lamps or other apparatus. It was the overlooking of this fact that caused the gentleman who tried to test a transformer with a 1,000 volt direct current on the primary, to witness some very surprising and startling effects on his instruments and converter.

LOSSES.

There are several sources of loss in a transformer which may be divided into two classes; magnetic losses or those which take place in the iron, and conductor losses or those which take place in the copper coils. The former comprise magnetic leakage, the loss by hysteresis due to the rapid reversal of the magnetism, heating of the iron core, and eddy currents; the latter, the drop or loss of voltage in

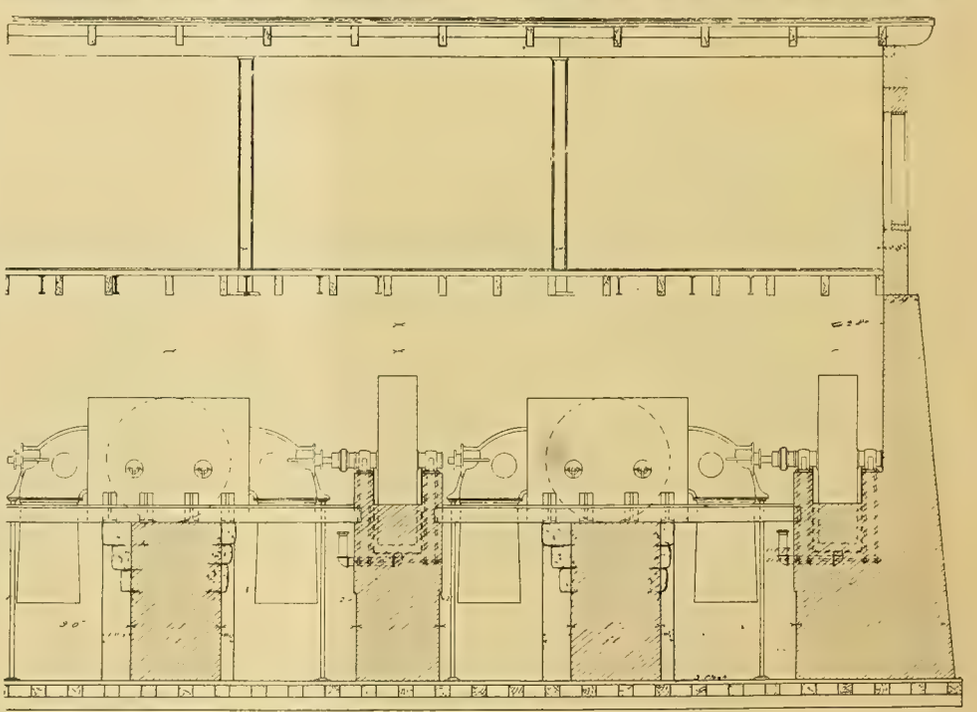


FIG 4. THREE-PHASE DISTRIBUTION AT CONCORD.

overcoming the resistance of the copper conductors and the energy dissipated in heat which varies as the square of the current passing. Magnetic leakage is due to the fact that some of the magnetic lines of force leak out along the core instead of passing through the secondary; this leakage effect is increased by the opposing magnetic action of the secondary to that of the primary, and the direct result is a lowering of the electromotive force of the secondary. Even when there is no load on the secondary, some magnetic leakage is taking place. When the transformer is running light the primary coil absorbs current enough to produce a field sufficiently strong to balance the voltage of the primary. The current thus absorbed is termed the "idle" current and it is of course necessary to have it very small. To force current through the primary an electromotive force must be supplied sufficient to counterbalance that induced by the magnetic field, and that lost by hysteresis and eddy currents and in resistance. The magnetizing current, which varies in accordance with the quality of the iron, produces the magnetization which forces the lines around the core and furnishes the energy wasted by hysteresis and eddy currents. The loss in the iron from the reversal of the magnetism is a constant one, whether the load is full, partial or none at all. This is clearly demonstrated by the presence of the "idle" current in the primary coil when none is being generated in the secondary.

The iron loss is independent on the induction, and the amount and kind of iron used. It is generally conceded to be most advantageous to have the losses in the iron as small as possible, because they are continuous and are going on all the time irrespective of the conditions of the external circuit. On the other hand the copper losses are only maximum during the periods of full or very nearly full load, which is not the general condition of the transformers, although it should be. Therefore it is unnecessary to have them unduly small. Furthermore the element of cost enters quite markedly into this portion of the subject. When there is no load there is practically no loss in the conductors.

CONSTRUCTION.

It is very important to have a well designed and carefully built transformer because the coal bill will be most wonderfully affected by the employment of wasteful and inefficent apparatus. We have seen from the properties of converters that the many conditions to be satisfied are quite contradictory and the course which improves one portion of the apparatus will be detrimental in some other way. In designing, therefore, it is necessary to strike a mean such that we obtain the best general effect as regards efficiency and reliability with moderate cost. The best transformer being the one that has the greatest output and efficiency with the least weight and cost. The insulation of the coils is of prime consideration and it cannot be too good. The primary and secondary coils must be insulated from one another and from the iron core thoroughly and with the best quality of material, of a character unaffected by heat or moisture and they must be securely protected from the weather which is done by incasing the entire converter in a water-tight iron case. For very high tensions the coils are often completely immersed in oil which gives excellent results.

The number of magnetic lines passing through the coils should be as great as possible, as then the amount of copper required in the coils will be small. The coils should be as small as possible and the employment of iron cores, which is always done, produces high magnetic induction with small current, thus cheapening the cost of manufacture.

Transformers are generally built with closed iron magnetic circuits to reduce leakage and keep down the primary magnetizing current. It may be well to mention here incidentally the "hedgehog" type of transformer due to James Swinburne which uses an open iron magnetic circuit of special form. The argument in favor of this plan is that while the magnetizing current and copper loss is larger the loss due to reversal of magnetism and heating in the iron which is always occurring is exceedingly small, and that on light loads particularly, this type will waste very little energy. It is, however, very questionable whether the general results are in the end superior to those of closed circuit transformers such as are generally used in this country and if properly arranged so as to work under favorable conditions the well-designed closed circuit type will probably prove to have decided advantages. Converters are generally constructed either with the copper coils surrounding iron or the iron surrounding the copper coils, and while in the first arrangement the amount of copper is less, the iron is more and in the second vice versa, they both give approximately the same results.

Care should be taken to have the resistance of the coils low to prevent drop of voltage and heating and the leakage small, and to carry out the latter condition the coils should be placed preferably one surrounding the other, but should not be wound so that their turns interlace or in alternate layers. The cores must be of finely divided iron, the laminations insulated from one another to reduce eddy currents and prevent heating. Stampings are generally used because the manufacturing cost is thus lowered. Sufficient iron should be employed to make the magnetic resistance low and prevent waste of current and power at no load or on light loads. Both coils and magnetic circuit should be short, with provision for sufficient room for the coils. A low induction must be employed to prevent undue heating, and the iron must not even at full load approach the saturation point. The coefficient of induction is the number of volts produced per foot of wire, and is found by measuring the current produced in the primary with the given electromotive force and number of alternations when the secondary is open. When obtained it enables all sizes of similar type to be built. The higher the alternations the higher this coefficient, but on account of the increased losses and other considerations the pres-

1. Read before the Northwestern Electrical association, Milwaukee, Wis., January 18, 1894.

ent tendency is toward lower alternations, which also permit of coupling the alternators safely and conveniently in parallel and make practicable the satisfactory operation of the various forms of alternating current motors which have been recently produced. In the great Niagara distribution the low periodicity of 25 is, it is understood, to be used for these and other reasons.

Testing transformers is essentially a laboratory operation, but is quite important, and a thorough comparative test of all the various makes by competent and disinterested persons with full data and tables of their performances under varied conditions would be most interesting to central station men. Naturally the way to obtain the efficiency is to measure by a suitable wattmeter the power delivered and that absorbed and divide the former by the latter. On account of the high pressure of the primary it is customary to use a small converter whose primary is connected to the high electromotive force and its secondary to the pressure coil of the wattmeter.

A well-made closed iron circuit transformer should give a high efficiency, not only at full load but also on light load. For measuring alternating currents the various dynamometer instruments and the well-known Cardew voltmeters are quite accurate for practical work, although probably the most exact way is to use the electrometer, which, however, is not well adapted for ordinary work as it is exceedingly delicate and requires suitable conditions and considerable skill and care in handling.

DISTRIBUTION.

It is quite as necessary to arrange the transformers for any particular distribution so as to obtain the most economical performance at all times as to secure transformers of high efficiency in the first place. With the primary pressure constant as the load on the station is increased, the tendency of the secondary voltage is to drop on account of the leakage and the ohmic resistance of the coils. This must be compensated for at the station so as to maintain the pressure of the secondary circuits constant to insure good service from the arc or incandescent lamps and motors that may be connected. A good transformer however, supplied with constant electromotive force, should give very nearly constant electromotive force on the secondary for all loads within its capacity. The usual condition of a lot of transformers run from a central station is that of light loads and often for a great portion of the time without any load at all. Under these circumstances it is easy to understand why they should use only a very small "idle" current, because power is being wasted all the while furnishing this "idle" current and heating the iron cores, and, as already pointed out, we can afford to sacrifice a little energy in copper loss, which only occurs during full or nearly full loads, to enable the continuous iron losses to be reduced to the very lowest possible point.

It has been observed by all operating alternating plants that with a non-inductive resistance, such as incandescent lamps, the drop under varying load is smallest, being greater on arc lamps and motors because of the presence of self-induction in the latter, and it is even possible to have an actual rise in pressure as was experienced on the long cables of the huge Ferranti station at Deptford, England, and ascribed to their capacity action.

For running arc lamps it is not desirable to have the periodicity too low; about 50 is generally used. The average loss in distribution by alternating currents is remarkably small, from 5 to 10 per cent., divided up about equally between the circuits and transformers. Loss of energy is proportional to the square of the current employed, and the weight of copper required varies inversely as the square of the electromotive force, or, in other words, one-fourth of the amount of copper is required to transmit any given amount of energy at twice the pressure, which with the large amount of power carried at high pressure and low current by the alternating system makes the cost of copper and waste of power both small and renders possible the long transmission, already carried out and those of even more daring proportions proposed.

It is evident that a small converter will not be nearly as efficient as a large one because the magnetic circuit cannot be as short, relatively speaking, or the copper coils as compactly arranged, and it will heat far more; it is also plain that a small converter will cost more per lamp output than a larger one. From these two most vital considerations large transformers are both cheaper and more economical and less of them are necessary. They can be just as desirably used as a number of smaller ones, by taking a little care in laying out the circuits and distributing them so as to reach as many consumers as possible with a single large transformer and its attendant advantages. At first sight it might appear as if the increased amount of copper used in the larger secondary mains would be injudicious, but this is not so (provided, of course, discretion is used) because the slight additional cost of conductors is completely overbalanced by the diminution of losses in the transformers, which are permanent and continuous.

The regulation of large transformers is also superior; they are much lighter for their output and cost less to install.

The difference in efficiency is quite marked between a 10 light converter and a 100 light one, for instance while the former will probably have a full load efficiency of 88 per cent. or 90 per cent. the latter will be as high as 95 per cent. to 97 per cent.

Summing up the conclusions arrived at, it is apparent that to fulfill the requirements of most economical operation transformers of the highest all-around efficiency under varying loads should be used, and, so far as circumstances permit, let them be large in size and few in number.

Representatives of twenty electric companies submitted bids to the board of county commissioners at Indianapolis on January 15th for lighting the county buildings with electricity. The commissioners will examine and consider each proposition in detail.

Proposed Down-town Loop for Chicago.

The plan to connect the terminals of the various elevated railroads of Chicago by a moving platform in the form of a loop in the business streets and on the same level as the elevated structures has reached the stage of serious discussion in the newspapers. The Central Construction company, incorporated to build and operate such a connecting railway, has adopted the principle of the "moving sidewalk" at the World's Fair, and it is proposed

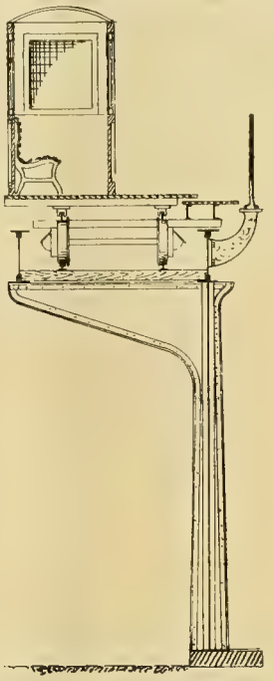


FIG. 1. PROPOSED DOWN-TOWN LOOP FOR CHICAGO.—SECTION OF PROPOSED OVERHEAD STRUCTURE.

to erect the structure on one line of posts at the curb line, projecting over the roadway, as shown in the sectional drawing, Fig. 1. It is contended that this plan reduces the light interference to a minimum and that it may somewhat increase the value of second floor windows on retail streets for display and advertising purposes. The extreme width of the proposed structure is ten feet, and the cars or platforms will be operated by electric motors supported on motor trucks, distributed at intervals of six or eight cars. The details of the manner of generating and transmitting the current have still to be arranged. As the cars will all be connected, the load will be quite evenly distributed on all the motors. It is proposed to provide entirely enclosed cars, in the proportion of about one in six, for the convenience of infirm persons or for use in inclement weather. The other cars will be open at the sides but surmounted by a glass roof supported on four posts at the corner of the platform. A section of one of the enclosed cars is shown in Fig. 1. As will be seen, the car only occupies about half the space on the platform, so that passengers can pass it without entering. It has not been decided whether there will be more than one moving platform around the whole loop. One plan contemplates but one continuous platform, moving at the rate of six miles an hour, with auxiliary platforms at the station landings operated by independent motors at the rate of two and four miles an hour. This would obviate the use of the flexible rail around the curves of the loop and thus do away with what proved to be a fruitful source of trouble at the World's Fair. It is also suggested that the slower auxiliary platform at a landing could be run down an inclined plane to the street, so that passengers could be lifted to the level of the "moving sidewalk," without climbing stairs, by simply standing on the inclined moving platform. In the street view, Fig. 2, an inclined "lift" of this sort is shown on the left, the ascent on the right being an ordinary staircase. This picture shows the appearance of the proposed structure at the corner of Clark and Randolph streets, looking east.

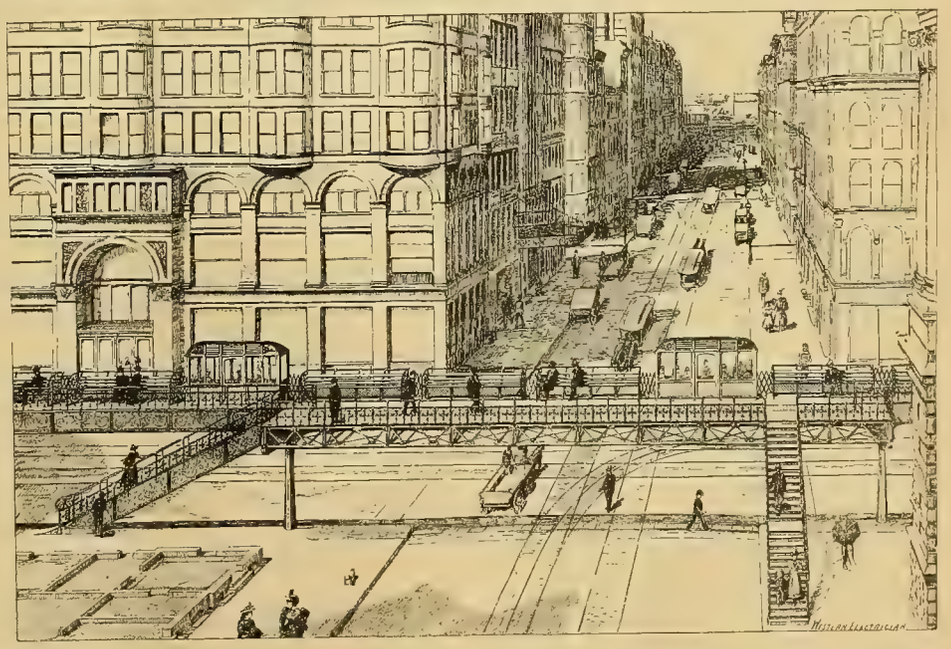


FIG. 2. PROPOSED DOWN-TOWN LOOP FOR CHICAGO.—APPEARANCE OF MOVING PLATFORMS IN THE STREET.

Economy in the Use of Transformers.[1]

BY PARMALEE J. MCFADDEN.

I am restricted by the title given me to tell of how transformers may be operated economically, and this relieves me of the task of roaming all over the subject of transformers and telling of all the possible ways in which they might be operated.

The paper which you have just heard read gives in more detail a description of various transformers and of the internal actions taking place in them, and, therefore, I will not bewilder you with my efforts to make this interesting phase of the transformer clear.

I will presume only that you all have stations operating an alternating circuit, or that those who have not are at least familiar with the principles underlying it, and why it is that a circuit of 1,000 or 2,000 volts is run through your streets instead of a harmless one of 50 or 100 volts requiring no transformation. Those of you who have paid large bills for copper conductors know this only too well. I will assume, then, that you are familiar with the system of distribution of energy by alternating currents in general. Nay, with apologies to those of you whose attention has been drawn to a better practice, I will assume that you are familiar only with the plan that has almost universally been followed during the few years that alternating currents have been handled commercially at all. This, then, will lead me to the particular phase of transformer practice about which I wish to speak to you today.

Let me first appeal to your sense of mechanics, which tells you that every machine (I think there are no exceptions, at least in the realm of electricity) will operate most efficiently at its rated load. Now a transformer is nothing more than a dynamo without moving parts, and is therefore no exception to the rule, in that it works best when loaded up to its rated capacity. In selecting a transformer for a given customer, the central station superintendent will too often install one capable of supplying the total number of lights for which the house is wired. In some cases this cannot be avoided, but in houses wired, say for 40 to 45 lights, it will seldom be necessary to put up a transformer any larger than a 30 lighter, and right here I would say that a transformer of a whole size smaller can often be used if the superintendent would take the trouble to consider the case of the particular customer in question. The neighborhood, the size of his family, and their habits relative to the probability of entertainments involving the burning of nearly all the lamps in the house, would all with a moment's consideration

1. Read before the Northwestern Electrical association, Milwaukee, January 18, 1894.

determine sufficiently closely what the maximum load would be. I think you all can think of a dozen or more of your customers who have much larger transformers than there is any necessity for, as often a house has been wired under the direction of a former tenant or owner, and outlets have been put in rooms far in excess of the requirements of the present occupant. Now the evils of this are two-fold. In the first place you have more money tied up in the apparatus than there is any necessity for; and second, the transformer is being run less economically than if its size were nearer that of the load it had to provide for. To make a rough illustration: You can carry a gill of water in a wooden pail as easily and as safely as you can in a teacup, but when you come to pour it out you will find that the teacup will net you a greater return than the pail. Similarly, but for quite different reasons, a 50 light transformer will transform the current for 15 lights, but the loss in the transformation will be greater than if you had used a 15 lighter.

I would say, then, that where you are obliged to use a transformer to each customer that your first consideration be the selection of as small a converter as the load will permit of.

But is it always necessary to install a transformer for every individual customer? Are not some of your stores, or even in some cases your residences, so bunched that one transformer could be made to do for several; and if so, would you not, if necessary, go to a little trouble with your secondary wiring to accomplish this? Even the bunching of say three moderately large transformers, to serve four or five consumers, where one or at most two are likely to have a large load at one time, and where this comes so seldom as to make it expensive to put up for each of them a transformer capable of taking that load, while a step in the right direction is seldom good practice, for if the primary fuse of one should blow, then not only does the secondary of that transformer (which is now dead, as far as its capacity to give out current is concerned) become a load upon the other two, but also the load of lamps it formerly carried must now be borne by the others. When this is the case the fuses of the other two will be likely to blow and the whole arrangement disabled.

One case has recently come to my notice, showing how in practice the substitution of one large transformer for several smaller ones has worked to the saving in first cost to the station, and as we know from the principle of the transformer, in the economy of operation as well. In this case a 90 lighter replaced one 15 lighter and five 25 lighters, which had been used to supply thirty-four store and saloon lights, forty-three residence lights and ninety-three church and society hall lights—these all being within a radius of 500 feet from the present large transformer.

Here there were 173 lights to provide for, and for which the station formerly had six transformers aggregating a capacity of 143 lights, and as these are now being taken care of by a 90 lighter, he has a transformer of a capacity of only 52 per cent. of the total lights connected, where before he had six transformers with a total of 80 per cent. of the lights connected. The conditions here were somewhat favorable, for the store lights would usually be out when the society hall, or certainly the church lamps were lit, as this would usually be Sunday night. In this case the superintendent took the trouble to observe the conditions and knew from experience what the maximum load of this combination would be, and he was thus enabled to choose a comparative small transformer to do the work of all, and to keep it well loaded all the time. From a cursory view of the conditions it might have seemed that certainly a 125 or a 150 lighter would have been necessary.

As the maximum load did not exceed 90 lights, and in fact the average load was about that, we will assume that the six transformers as originally installed were loaded as follows:

1 15 light at 2-3 load	= 10 lights	= efficiency say	94%
2 25 light at 1-2 load	= 25 lights	= " "	94%
2 25 light at 3-4 load	= 38 lights	= " "	95%
1 25 light at 2-3 load	= 17 lights	= " "	96%
	90		

This would make an average efficiency of 94.3%. Now a 90 light transformer at full load would operate at about 97%—a saving of at least 2 1-2%. Then comes the question of regulation or the drop in potential of the secondaries when running at high loads as compared with that when running light. When the individual transformers were installed separately it frequently occurred that at times one or more might be carrying a very light load and the addition of a very few lights would be a good many per cent. of the transformer's load, and the voltage would drop—and show in the dullness of the light. Where a large transformer is installed, that same number of lights is a very insignificant portion of the whole load, and no appreciable change in the voltage is noticed in suddenly switching them on or off. In this particular case, the station superintendent reports that there is a noticeable improvement in the steadiness of the light.

Another case I have in mind is where a 125 light transformer replaced two 40 lighters and one 25 lighter connected with nine residences containing 143 lights, and to these were added three more residences with 130 lights, making in all twelve residences having 273 lamps wired up. Thus all the lights are supplied by a transformer of but 45% of the total lamp capacity wired up.

Aside from the advantages of regulation and efficiency which are far reaching, in that their effect is operating continually, there are other and quite as palpable ones that especially recommend this system. Perhaps first of all comes the saving in the first cost. You all know how much cheaper, say, one 100 light transformer is than 100 light capacity in smaller sizes. This plan not only preserves to you this advantage in first cost of large transformers, but, as has been shown, also permits of your using a very much lower capacity than the aggregate of the lamps wired up. There is a greater saving in the cost of installation and in the cost of repairs. Further than this, the danger from lightning in the primaries is reduced at least in proportion to the number of transformers replaced.

For the purpose of illustration, and to make the matter appeal to you if possible more than the bare statement, I have given you the above examples, as being actual practice of one of your number, and I think the application is sufficiently clear to appeal to you in instances which many of you no doubt could bring to mind, where such a plan could be worked to the great benefit of your stations.

I have spoken until now of the use of large transformers with secondaries connected on the ordinary two-wire system using, if desired, and the distances are not great, 52 volt lamps; otherwise 110 volts; but why stop here? The very reason why you adopted the alternating system was on account of the saving in copper in the mains and feeders, and you did this by sending a small current to a great distance at a high voltage, knowing that it is only amperage that demands a large cross section of copper. Now why not apply this principle to the secondary wiring as well, using as high a voltage as is permissible in practice. Manifestly this can be accomplished by running the secondary wiring on the three-wire system, having a difference of potential of 220 volts between the outside wires, and using 110 volt lamps. Here again we introduce a feature that, added to those above enumerated as being present in the use of large transformers, makes the system of three-wire secondary wiring from transformers the most efficient that modern practice is capable of. The loss in the secondary wiring is here cut down to a minimum, as the current is only one-fourth of what it would be with an equal number of lamps of 52 volts, and for the same percentage of loss the actual drop in volts can be doubled. As a consequence the wire for a 220 volt circuit would need to be but 5-64 of that for a 50 volt circuit for the same cost. A number of cases of this method of wiring are in Chicago in theaters and large buildings, which is a class of work to which this can be applied as advantageously as with outside work. In the example first above given, where a 90 light transformer supplied lights at a distance of 500 feet, there would have been great saving in the secondary wiring even if two 50 lighters had been used, but the secondaries run on the three-wire system.

Ordinary transformers can, of course, be connected in pairs with their 100 volt secondaries in series and run out on three wires, but a still greater saving is secured in using a transformer whose secondaries are so brought out that a three-wire service is obtained directly from the one transformer.

As being directly in line with the subject of this paper I might have spoken of the transmission of energy by the three-phase system—a plan that is being adopted largely where an inexpensive water power is located some miles distant from the point at which the light or power is to be used, and, even more recently, in ordinary stations.

Another and a somewhat older plan for transmitting the energy to a great distance is to generate the current at say 1,000 or 2,000 volts, as usual, and in the station have a "step-up" transformer which will transform the current to one of 5,000, 10,000, or 20,000 volts and to send it at this high pressure over the five or ten miles to the locality in which it is to be used. Here will be provided a "step-down" transformer whose function is just the reverse of the "step-up," that is to say, it will convert the say 10,000 volt current to one of 1,000 or 2,000 volts, and at this pressure it can be distributed through the town just as if a 1,000 or 2,000 volt dynamo in the town were furnishing the current. From these primaries the distribution to individual consumers is identical with ordinary practice.

Of course the chief advantage of this plan is in using an inexpensive water or other power plant, although removed at a great distance from the point of application.

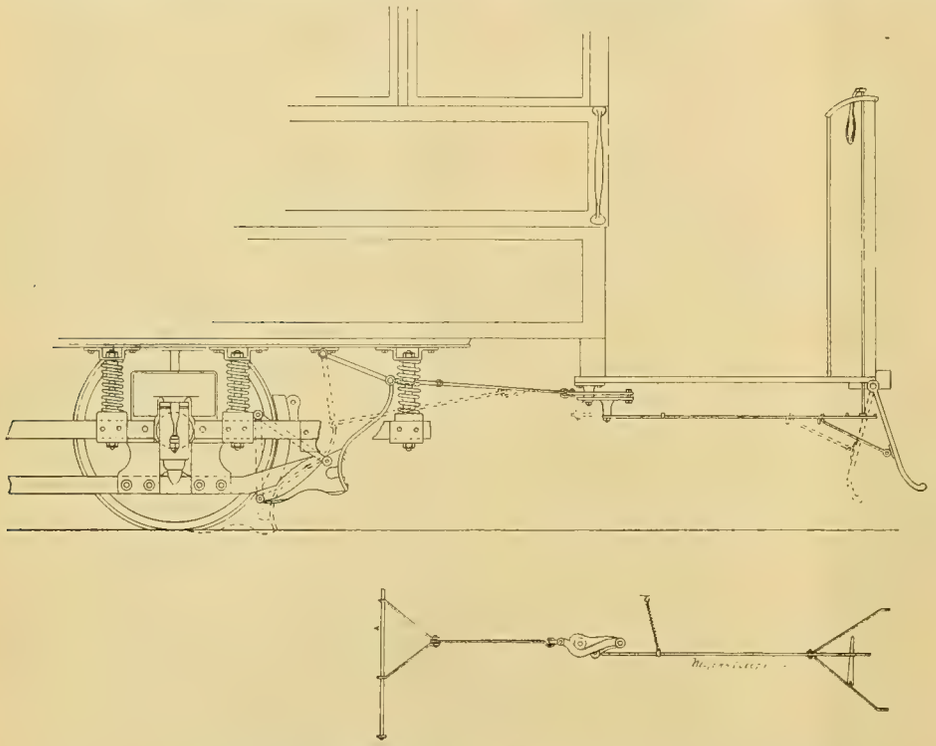
Opportunities for the employment of this latter plan are rare in stations in this section, and I have purposely confined my remarks to the employment of large transformers on the two-wire, or, better yet, two transformers with secondaries connected in three-wire, or still better, and best of all, one large three wire transformer, thinking that as applications of these can be made in the plants of each of you who is using alternating current, the matter would be emphasized and would appeal more forcibly to you than if I had made this short paper more general in its character.

Manufacturers are loth to advocate this substitution of one large transformer for several small ones, as such a plan, universally used, would affect very materially the amount of their business, for the cheapest way to buy transformers is to get large units, and they are in no hurry for customers to find this out. The flood of second-hand small-sized transformers of which second-hand dealers have doubtless given you due notice, is only an evidence that somewhere large transformers have supplanted an enormous lot of smaller ones, and the tempting bait of low prices for this discarded apparatus is difficult to withstand, and a station superintendent is almost blinded to the merits of the large transformers by the dazzling brilliancy of these "bargains."

The whole thing is a matter of simple arithmetic, and without knowing in detail any of the conditions of your individual plants, I feel assured that a rough inspection will reveal several places where a judicious grouping of your customers could be made, a large transformer or a three-wire plan adopted, and the replaced transformers used on new consumers where the plan will not work so well.

If I have succeeded in interesting you in this subject, those of you who have not already tried this, or whose attention has not heretofore been drawn to it, I shall feel amply repaid for my time, for I know that your desire for the economic running of your plant will prompt you to look into the matter further and to test its soundness in your individual stations.

Allow me to thank you for being permitted to address you and for your attention in listening to me.



AUTOMATIC DEVICE FOR STOPPING ELECTRIC OR CABLE CARS.

Automatic Device for Stopping Electric or Cable Cars.

It is undoubtedly true that many of the accidents charged to the trolley and cable cars in large cities are due to the fact that the men in charge of the operation of the cars, either through incompetence or positive inability, fail to stop the cars quick enough. This has been notably the case in Brooklyn, where the reputation of the overhead trolley system has been made to suffer by reason of the negligence of the motormen and the crowded condition of the streets. Anything that will tend to approximate an instantaneous stoppage of the car in case of an emergency by means not dependent on the activity of human muscle will be of great value; and it is claimed that this result can be reached by the employment of the device represented in the accompanying drawing, which is put out by D. McFarlan Moore.

An automatic device of this character should instantly

cut off the source of power, brake the car in the most effective manner and prevent anything from being crushed beneath the wheels. It is asserted that all of these requirements are met by the apparatus under consideration.

The device is operated automatically by pressure upon the hinged projecting fender, or by the motorman at will. Either method moves the rod under the car platform, cuts off the current or releases the cable and swings the shoes down upon the track under the wheels, which run up slightly on the shoes, blocking the car. By this method it is impossible for anything to get under the wheels, and it will be seen that the heavier the load the more effective the braking, particularly if the under surface of the shoe is slightly roughened, and for this purpose the shoe may be constructed so that the roughened surface bears upon any desired part of the rail to prevent excessive wear. The shoes on either side of the car may be connected with a light wire fender, to keep anything from getting under the body of the car, or if preferred the usual board fender may be fastened directly upon the shoes.

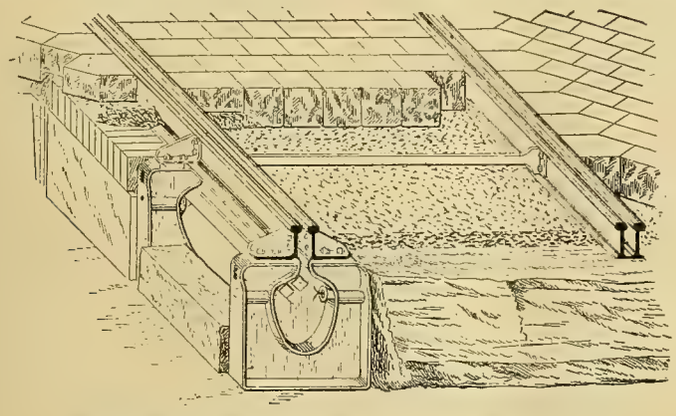


FIG. 4. THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.

The mechanism at the point directly under the front of the body of the car, where the rod running from the hinged fender connects with the rod running to the shoes—separately shown in the cut—is a simple lever, for the purpose of obtaining greater movement and of throwing the weight of the shoes upon a dead center, it being kept there by the slight spring shown in the cut. This arrangement keeps the shoes in their proper position when raised, offers a ready means of adjustment both as to movement of parts and delicacy of action, and prevents any operation except in the manner appointed.

The shoes may be lowered or raised as already stated by the motorman by means of the lever upon the platform. The handle of this lever is hinged so as to drop into a slot to prevent it being turned accidentally, and this does not interfere with the operation by the hinged fender automatically.

It is not claimed that each distinct part of this device is new. It was put forth simply as a combination of well known mechanical devices, for the accomplishment of obvious purposes. It is effective, inexpensive, cannot easily get out of order, and is not cumbersome or unsightly.

The Practicability of Electric Conduit Railways.

By Albert Stetson.

Part III.

THE BUDA-PESTH ROAD.

At Buda Pesth, in Hungary, is the only conduit road employing a bare conductor that has ever achieved measurable commercial success. The best description I have been able to obtain is found in the book of Mr. Hering: "Recent Progress in Electric Railways," pages 175 *et seq.*

"The conduit. (Fig. 4.) is placed under one rail. It consists of castings having flanges of 18 centimeters (7 inches) placed every 1.2 meters (about 4 feet), the space between being a conduit of concrete. The oval shaped conduit has a width, clear, of 28 centimeters (11 inches), and a height of 33 centimeters (13 inches).

"The slot consists of two beam rails having no inside lower flange, and fastened to the conduit frames by wrought-iron angle pieces. The width of the slot is 33 millimeters (1 5-16 inches); the total depth of the foundation below the rail top is 70 centimeters (27½ inches). The conductors, both positive and negative, are made of angle irons, secured, as seen in the figure, by means of insulators fastened to the castings. They are sufficiently high above the floor of the conduit to be protected from the water which may collect in the conduits. They are, furthermore, under the top of the oval, so that they cannot be touched from the outside. It should be noticed that there is no earth return used with this system, as both leads are insulated. The water which runs into the conduits is collected at the lowest points, and passes through settling boxes to the sewers. The second track may be of any desirable form, even only a flat rail. An objection to having the conduit under one rail instead of in the middle arises in cases where, by the nature of the course of the track and the curves, the cars become reversed in their positions on the tracks such cases can probably be avoided by proper laying out of the road, and in the worse case by a second conduit under the outer rail for parts where it cannot be avoided. On a one-track line the cars must have their front and back platforms alike, as they cannot be turned around."

"The car truck and the motor are the same as those used in connection with their overhead system." * * * "Only one axle is driven; the other is flexibly connected to the third point of support of the motor frame. The starting, stopping and reversing of the motor is done as usual by a crank at either end of the car operating the same switches. Controlling resistances are placed under the body of the car."

"In a public address, one of the engineers of the company stated that the latest figures (July and August, 1891) of the cost of running were only 37 per cent. of the income, which certainly is remarkably low."

In this place I wish to call attention to two facts—first, that the width of the slot is greater than could be allowed in any American city, since it would let into the conduit and wrench the wheels off two-thirds of our carriages. This system must have that width, since their conduit uses one of its slot-rails as a rail for the wheels of the car, and they must have the width to give room for the flange of the car wheel. The second point I wish to call attention to is the fallacy of giving the ratio of operating expenses to the net receipts. That can be manipulated in such a way that it is impossible to draw any sure conclusions therefrom. Only a short time since a gentleman connected with the electric railway in the city where they claim to have the best roads in the country told me their operating expenses were only 45 per cent. of their receipts. Any fair way of reckoning "operating expenses" means that, in this case, salaries and cost of running were 45 per cent. of their total expenses. If that is so, what becomes of the other 55 per cent. of income? Does it go into the pockets of the shareholders, or do the officials make way with the difference between a "tight squeeze" 7 per cent. dividend and the large margin between 55 per cent. and 7 per cent? I am sure that no member of this Institute will be deceived by any exceedingly small "operating expenses." Another point to be noticed above is that they use only 300 volts potential. Most of us believe that Mr. Daft, in his experiments years ago, exhausted the practicabilities of electric traction at 300 volts. But perhaps the volts are individually more powerful in Buda-Pesth than the "North American volts" used in New York.

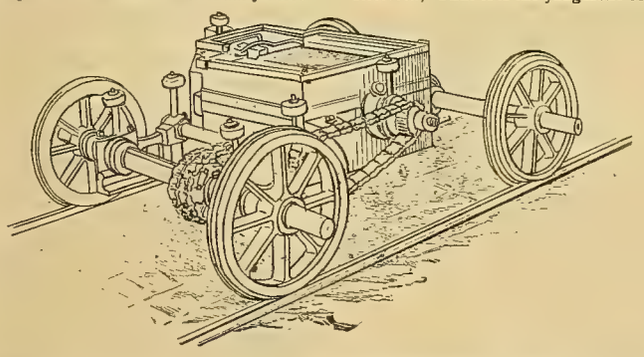


FIG. 5. THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.

Crosby and Bell's book, quoted frequently before, says (page 258): "As will be seen from the description just given, the conduit itself possesses no very extraordinary features; it is simply well made, substantial and carefully drained. This latter fact is probably the most important factor in the very good results obtained. The concrete conduit is of itself a fair insulator, and serves as an additional security against grounds."

The Buda-Pesth record is certainly remarkable, standing alone as successful among all the failures that have attended conduit experiments. It has not, however, been all plain sailing, and they have had some interruptions in their traffic. What success has attended the Buda-Pesth road has been due to several causes, first of all coming the excellent workmanship that goes with everything done by the world renowned firm of Siemens & Halske. Next come the beautiful streets of Buda Pesth, no city in the world excelling it in finely kept and well drained streets. Labor is very cheap there; large numbers of men can be employed to keep the streets clean and the conduit clear, while our dear American labor would make "operating expenses" tell a sad tale. Third, an equable climate, enjoyed in none of our cities. Snow seldom falls there, and the rain-fall is not great. Such a state of affairs, so many favorable conditions, would be found nowhere in America, and until they are found combined, there is no good reason for thinking that the Siemens & Halske system, employing the same bare conductor and the same construction that has failed here, would do any more than add one more wreck on the shore of conduit ventures. You must remove that bare conductor from the conduit, change the climatic conditions of our country, change the laws of nature and of electricity, or you cannot have a commercially practicable conduit system of that type. We must have a system that does not require us to change our streets and our climate, but that will take the rough-and-tumble conditions as they exist in all our towns, overcome climatic difficulties, pay no attention to flooded conduits and poor drainage, and work summer or winter, whether the sun shines or not. If a road has a grade, and a heavy shower suddenly comes up, the water will collect in the hollows faster than any practicable drainage system can carry it away, and the successful road must work right along, undisturbed by such trifles. Any bare wire laid in a conduit, call the system by whatever name you will, must inevitably break down under such conditions. But an electric system, like any other traction system, should never break down, more especially in bad weather, when the public most need traveling accommodations.

There remains still one class of conduits to be considered before passing to the system that has shown a solution of our troubles, or as near it as we can reasonably hope to come in the immediate future.

CLOSED CONDUITS

The idea of a closed conduit has had charms for many inventors, and much midnight oil has been consumed over this problem. The same difficulty is met with in all of them, viz., the continuous grounding of the live wire. Where magnets are used to switch in short sections of the line, they have proved a constant source of trouble. Such things often show up well in the office model, but railroads do not run in offices. All of us who have had any experience with automatic electro-magnetic switching devices know that the less number we have of them the better they work, and that we avoid them wherever it is possible. In the closed conduit, or surface contact systems, there is necessarily a momentary grounding. On a dry day, with one car, the loss might be hardly noticeable. But wet and muddy days will come in spite of the prayers of the electrician, and I always picture to myself Broadway on a muddy winter's day, with a jam of cars reaching from the Battery to the Postoffice. Perhaps, there might be 50 or 75 cars in the line, and any system grounded in 75 places will certainly break down.

Among those who have worked most in this field may be mentioned Pollak, Lineff, Gordon, Wheless, Schuckert, Edison and Van Depoele. Their systems have all very much in common, and the fundamental idea is the same.

Chicago Edison Company.

The Chicago Edison company proposes to issue $2,000,000 additional stock, which will make the total capital of the company $5,000,000. The growing business of the company and the extensive additions it is making to its plant render this necessary. The board of directors passed a resolution at a meeting on January 16th as follows:

Resolved, That it is the judgment of the board of directors of this company that an addition of $2,000,000 should be made to the capital stock of the company, making the total capital stock $5,000,000; that $1,200,000 of said additional stock should be offered to stockholders at par, subscriptions to be payable in three installments, as follows: Fifty per cent. on April 1st, 25 per cent. June 1st, and 25 per cent. August 1st, and that after the allotment of such royalty as may be required for the Edison Electric Light company the remainder of said additional stock should be held in the treasury of the company, to be disposed of as the board of directors shall consider for the best interests of the company.

A special meeting has been called for February 21st, at which the increase will be formally voted upon. The books of the company will be closed from February 15th to February 23d.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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WE have tried advertising in several electrical papers, and after discontinuing our advertisement in your journal [*Electrical World*] we advertised for a considerable period in the WESTERN ELECTRICIAN, which we found a valuable paper for reaching the West, our card in that paper bringing us many communications, a number of which resulted in sales of our alternating apparatus, including a plant for the University of Wisconsin.—*Extract from a letter of F. A. La Roche, president of the La Roche Electric Works, Philadelphia, to W. J. Johnston, publisher of the Electrical World.*

TWO prominent members of the New York Legislature, Assemblyman Wray and Senator Bradley, are endeavoring to secure the passage of a bill in which street railway men will be interested. It provides that "all exposed wires used in operating by electricity as a motive power by railroad corporations and others shall be properly and efficiently insulated." It might be well for the members named to recall the bill and modify it somewhat. Possibly they may have a new method by which insulated wire may be used as a trolley wire.

IN a recent address before the Société Internationale des Electriciens at Paris, E. Hospitalier, in describing what he had seen of the electrical development in the United States, on the occasion of his recent visit, is reported to have said that "two rival companies—the General and the Thomson-Houston—effect distribution at 1,000 volts," etc. Were it not for a number of palpable misstatements in Mr. Hospitalier's address we might be tempted to believe that the Parisian electrician had advance information of what many people believe to be an impending change of great interest to the electrical fraternity. But it is altogether probable that the statement did not express the intent of the speaker. In view of current rumors, however, the coincidence is remarkable.

A PROMISING field for the introduction of electric locomotive headlights is in the South, where the cows have rights on the tracks that the railroad companies are bound to respect. In Alabama, for instance, the courts have held that the trains must be run in such a manner at night that cattle can be seen by the engineer in time to prevent injury. This requirement makes it necessary to abandon all pretense at speed in night trains or else to use such a powerful headlight that the cattle can be seen far enough ahead to enable the train to be stopped in time to prevent the threatened collision even when running at a good rate of speed. The latter alternative is, of course, the preferable one; and, as the electric headlights are the only ones furnishing light of sufficient intensity, it follows that there exists a considerable demand for them among southern railway managers. With judicious missionary effort, there is little doubt that this trade could be largely increased.

IS THE time coming when a horse will be as much of a rarity on city streets as an ox-cart is now? A writer in *Harper's Weekly*, observing the multiplication of mechanical and electrical methods of propulsion, predicts that this will be the case. Already the trolley car, the cable rope and the bicycle have supplanted the power of tens of thousands of horses in American cities, and when electricity can be sold more cheaply than at present, and when charging stations have multiplied—perhaps at the time when cheap water power is transmitted long distances to New York and Chicago in the form of electrical energy—the pleasure carriage, the delivery wagon and the heavy dray will undoubtedly be superseded by electric vehicles. The horse seems destined to be a constantly diminishing factor in city life; and, in view of the vastly improved condition of the streets that would result from his departure, he can well be spared.

IT IS a gratifying fact that in cities where the overhead trolley system has had a thorough trial the "deadly trolley cry" of the New York newspapers excites only ridicule. Rochester, N. Y., with one of the best managed street railways in the country, is such a city, and the manner in which the trolley bugaboo is regarded there is indicated by the following quotation from the editorial columns of the *Rochester Herald:* "One thing is noticeable in connection with the trolley car in New York and Brooklyn. When one of them kills a pedestrian a great hulla baloo is raised and particulars are stretched to the extent of a column, with display headlines. But when an antiquated horse car provides work for the coroner the fact is dismissed with fifteen or twenty lines of mention." Overhead construction is not an ideal method of conveying electrical power to the car motors, but it is the only known method that has proven successful; and those who are attempting to cry it down by a systematic course of sensational falsehood are simply opposing the inevitable and holding themselves up to ridicule.

AMUSING instances of British ignorance of American customs, laws and habits are continually cropping out in the English press. But it is strange that a technical journal, like the London *Electrical Review*, should fall into an error so curious as the one contained in the following paragraph:

Prendergast, who murdered Carter Harrison, mayor of Chicago, on October 28th last, was, on December 29th, sentenced to death for his crime at the Chicago Criminal Court. The jury expressed an opinion, which they embodied in a recommendation, in favor of Prendergast being hanged instead of being executed by electricity. Apparently our American friends are getting a little shy of their new method of capital punishment by electrocution, but we were not aware that this mode of execution was common to the United States generally.

Inasmuch as the laws of the state of Illinois do not permit of the execution of condemned criminals by electricity, it would be interesting to know where our contemporary got its information. We believe that New York is the only state in which the death penalty is carried out by means of electricity.

A NEW feature is introduced in the incandescent lamp litigation by the decision of Judge Ricks in the Buckeye company's case, which is presented elsewhere in this issue. The validity of the Edison patent was not questioned in this case, but the point was raised that the patent had already expired by reason of the voluntary limitation of the patent by the Edison interests. The Buckeye people had made a large investment of money—fully $125,000—in a plant for the manufacture of incandescent lamps, with the intention of beginning operations November 10, 1893, the date when the Edison patent would expire by limitation. But in March, 1893, acting on a decision of the Court of Appeals at New York, the Edison Electric company applied to the commissioner of patents to cancel the limitation of the patent and allow it to run for the full period of seventeen years. Judge Ricks held that the opinion of the Court of Appeals did not prohibit the voluntary action of the Edison company in limiting the term of its patent. Inasmuch, therefore, as the Buckeye company, acting on the assumption that the limitation was in force, had made preparations to avail itself of the privileges conferred by expiration of the patent, it would be an injustice to that company to permit the later action of the Edison company to work an estoppel, and the injunction was dissolved. Just how far the decision will affect other companies remains to be seen. The General Electric company announces that its policy in following up this litigation has in no way been modified, and that the case will be pushed to an early trial. At any rate, the lamp companies are very much encouraged by the turn affairs have taken, and they will not be slow to take advantage of this point.

THE discussion of the proposed branch meetings of the American Institute of Electrical Engineers is revived by a communication from Townsend Wolcott, which is presented in another column. Mr. Wolcott evidently does not realize that the plan of organization under which the Institute is now conducted is entirely different from that of the federal government. The latter is representative in character; each department, whether it be legislative, executive or judicial, has certain powers and duties specifically conferred by the constitution. In the case of the Institute there is no representative body governing the organization, but there is a small coterie of New York members, probably 40 or 50 in all, who assume to make rules at "special meetings" for the 700 members who do not attend these little gatherings. As a matter of fact, there is no authority for these proceedings, and if occasion should arise they could undoubtedly be overturned. The meeting at which the question of establishing "branches" was considered was attended by less than 40 members. And yet it was at that meeting that President Houston announced with befitting solemnity:

"We are the Institute."

As a matter of fact, all important matters should properly be considered at the annual meetings. The New York members have no more right to make rules for the organization at their special meetings than would a handful of members in any other part of the country. The fact that the "headquarters" of the Institute are in New York is cited by the New York members as important in this connection, but a moment's thought will show the fallacy of this argument. The headquarters of the Institute,—in other words, the secretary's office—could be located in Chicago, St. Louis or Kansas City, and none of these cities would claim the right to run the affairs of the entire organization. Prof. Houston regretted that the remarks of the members were reported and printed, but many non-resident members, we are sure, would protest against a discontinuance of this arrangement, as the proceedings, as reported, are interesting, and at times quite amusing. Then, too, as long as the New York members continue to run the Institute it is well that the rest of the members have an opportunity to follow their movements and learn what these distinguished gentlemen are doing for their less fortunate associates.

Incandescent Lamp Litigation.

As announced in the last issue of the WESTERN ELECTRICIAN, Judge Ricks granted an order dissolving the preliminary injunction of the Edison Electric Light company and the Edison General Electric company against the Buckeye Electric company. The arguments were heard in the United States Circuit Court for the Northern District of Ohio, and the decision was given at Cleveland on Tuesday of last week.. Judge Ricks' recital of the facts in the case and his opinion are herewith presented:

STATEMENT OF THE CASE.

This case is now before the court upon a motion to dissolve the preliminary injunction allowed herein on the 28th day of July, 1893. Said injunction enjoined the defendant from using lamps infringing the second claim of letters patent No. 223,898, for the alleged infringement of which the bill of complaint was brought. The motion recites what the record discloses; that the letters patent upon which the bill is filed bear date the 27 h day of January, 1880, and purport to be for the full term of seventeen years from that date; that after said letters patent were issued, and on or about the 15th day of November, 1883, Thomas A. Edison, to whom said letters patent were granted, filed with the commissioner of patents of the United States a duly verified petition, wherein, among other things, he alleged that while his said application for letters patent was pending he applied for and obtained letters patent for the same invention in several foreign countries, to-wit: British patent, dated November 10, 1879. No. 4 576; Canadian patent, dated November 17, 1879, No. 10 654; Belgian patent, dated November 29, 1879, No. 49,884; Italian patent, dated December 6, 1879, and French patent, dated January 20, 1880, No. 133 756; and that no other patents were granted upon his invention in foreign countries before the grant of said United States patent No. 223,898; and at the time of filing said application for said United States patent, and while the said application was so pending, he was advised that the rules and practice of the office, under the prevailing construction of section 4,887 of the Revised Statutes of the United States, did not require an applicant to acknowledge during the pendency of his application a foreign patent applied for and granted subsequent to the filing of such application, and that he therefore did not acknowledge the above named foreign patents, and that the United States letters patent were granted to him, unlimited, for the full term of seventeen years. He further, in said petition, tendered said letters patent No. 223,898 to the commissioner of patents, and requested that they be corrected so that his said patent should be limited to expire with the date of said foreign patent, referred to in his petition, having the shortest time to run. The said petition of Thomas A. Edison for such correction of his said patent was duly consented to and concurred in in writing by the Edison Electric Light company, to which the said Edison had assigned the said letters patent.

The motion further alleges that the United States commissioner of patents, upon the filing and due consideration of said petition for the correction of said patent, granted the said request of the said Thomas A. Edison and the Edison Electric Light company, and accepted the surrender of said patent for the purpose of such correction, and corrected said letters patent in accordance with the request made in said petition and endorsed thereon such correction, wherein and whereby said letters patent were, at the election and request of the said complainants, limited so as to expire at the same time with the foreign patent having the shortest time to run, naming said patents as hereinbefore described, and certified that the proper entries and corrections had been made in the files and records, and that the said amendment was made that the United States patent might conform to the provisions of section 4887 of the Revised Statues.

Said motion further avers that said British patent No. 4,576, dated November 10. 1879, was for the same invention as that for which the said United States letters patent aforesaid were granted, and as your petitioners are informed, advised and believe, and therefore allege, was for the term of fourteen years from the said November 10, 1879, and that said British patent No. 4,576 has now expired.

Said motion further avers that the defendant, the said the Buckeye Electric company, was organized for the purpose of manufacturing and selling incandescent lamps in the month of February, 1890; that at the time of its organization it had an authorized capital of $100,000, and its investment at that time was about $25,000; that before said business enterprise was started and said capital invested the parties interested in the enterprise made diligent examination of the records of the patent office with reference to patents pertaining to incandescent electric lamps, and also informed themselves as to the prevailing understanding of the trade and persons engaged in similar enterprises as to the rights of parties to manufacture incandescent electric lamps, notwithstanding said letters patent No. 223,898 and other patents professing to cover the manufacture of incandescent electric lamps at that time, and, among other things, ascertained that the Circuit Court of the United States, in case heard by Mr. Justice Bradley, had decided to be invalid a certain patent upon incandescent lamps, known as the Sawyer-Man patent, which was considered by the trade, and all parties interested, as being in all respects as valid as the said letters patent No. 223,898, which patent was commented upon and referred to in said case, and that at the time of said ruling, the electrical engineers and all parties interested throughout the country accepted that decision as holding that the public generally were free to make, sell and manufacture incandescent electric lamps in the form now claimed, and subsequently decided to be an infringement of the letters patent in the bill of complaint described. And prior to the time that said Buckeye Electric company engaged in the business there were many other concerns in the United States manufacturing incandescent lamps, among the principal of whom were Sawyer-Man company of New York city; Thomson-Houston company of Lynn, Mass.; Bernstein company of Boston; Sunbeam Incandescent Lamp company of Chicago; Perkins Incandescent Lamp company of Manchester, Conn.; Brush-Swan company of Cleveland, Ohio, and others; that none of these companies had ever been sued by the owners of the Edison patent, as called.

Said motion further avers that the defendants and those interested, also ascertained from such investigation that the particular patent in suit in this case was then believed to have expired by reason of the termination of the Canadian patent covering the same invention, issued on November 17, 1879, it being, as was then understood by the petitioners, the prevailing opinion of the courts that the termination of the Canadian patent, by the decision of the deputy commissioner of patents, terminated at the same time as the Edison patent sued upon herein, which had been issued in the United States subsequent to the date of said Canadian patent, and it was the distinct understanding of the defendant at the time said company began business that there was no valid patent outstanding which could in any way interfere with their carrying on the proposed business of manufacturing and selling incandescent electric lamps. And the defendant, in common with other manufacturers throughout the United States, continued business with its said investment of about $25,000, until the summer of 1891, without molestation or threat of interference by anyone claiming the patents were infringed by the defendant; that in the summer of 1891 the defendant, the Buckeye Electric company, having some months before that time discovered and put into practical use a filament superior in every respect to that which was then and is now used by the complainants herein, had so far increased its business that it became necessary to largely increase its investment. And thereupon further examination was made by the parties interested in the said Buckeye Electric company's enterprise as to the patent of the said Thomas A. Edison, and it appeared from the examination which was then made, for the second time, that said letters patent had been, upon the petition of Thomas A. Edison, as hereinbefore described, corrected so that said patent was limited to expire with the aforesaid patents issued by foreign countries having the shortest time to run, and that said patent would expire on the tenth day of November, 1893; that consequently the United States letters patent would expire at the same time. And thereupon, and before any ruling had been made by the Circuit Court of of the United States sustaining the validity of the said Edison patent, and in full reliance on said petition, and with the concurrence and consent of complainants, as hereinbefore set forth, and upon the certificate of the patent as issued and corrected, limiting its term as aforesaid, the said defendant, for the further purpose of introducing its improved and superior filaments, further increased its investment in said electric light business, so that it now has, and since said summer of 1891 has had, invested in said business and in connection therewith, about the sum of $125,000. The motion avers that said investment was made in good faith, believing that in no event could the United States letters patent of the said Thomas A. Edison continue in force longer than November 10, 1893, which said defendant was induced to believe by the action of the said Edison and his associates as hereinbefore recited.

The motion further avers that after the decision of Judge Wallace, hereinbefore referred to, an appeal was at once taken by the parties to said suit, so that the defendant and others in the same line of business continued to manufacture lamps pending said appeal; that shortly thereafter negotiations were opened between the defendant and complainant with a view of completing some arrangement by which a sale or consolidation of interests could be effected; that these negotiations were carried on constantly from about September, 1892, until February, 1893, during which the defendant operated its factory, with the acquiescence and substantially at the request of said General Electric company, and materially increased its capacity at the suggestion and request of the said General Electric company. These negotiations finally failed, and immediately upon such failure the defendant closed its factory by reason of the ruling of the Circuit Court of Appeals for the Second Circuit, sustaining said claim of the Edison patent, and said factory remained closed until a subsequent decision of Judge Hallet, in the Eastern District of Missouri, in a case in which the Goebel defense to the validity of the Edison patent was presented and the complainants were refused an injunction. Upon such ruling the defendant opened its factory, and continued manufacturing until the decision of Judge Seaman, of Milwaukee, when the defendant again closed its factory, and said motion avers that said defendant has at no time knowingly or wilfully infringed complainant's rights.

By reason of the premises the defendant avers that said United States letters patent No. 223 898, so far as the rights of the defendant to now manufacture lamps is concerned, is no longer in force, said invention having been, by the voluntary act of the owners, as hereinbefore described, dedicated and abandoned to the public; and that by reason of said action the public generally, and especially the defendant, has thus made large investments upon the faith of the expiration of said patent at the date to which its term was so expressly limited by request of the owners thereof, and have now the right to manufacture and use and sell the lamps covered by said patent, and that the complainants, by reason of the acts aforesaid, are estopped to claim any benefits under said patent as against the defendant since November 10, 1893.

This motion is supported by affidavits of the officers of the defendant and by most of its directors, each of whom avers the truthfulness of the facts hereinbefore set forth.

The complainants in reply file affidavits in which they admit the proceedings in the Patent Office, substantially as set forth in the defendant's motion, but declare with great particularity the circumstances under which said proceedings were taken, alleging and claiming that the same were taken under a mistake of law and under the advice of eminent counsel. They further deny that the defendant was misled by the negotiations set forth in their motion, and that they in any way impaired their legal rights to insist upon a continuation of the injunction now in force. They further deny that the defendant was mislead by reason of complainants' conduct because of the proceedings in the Patent Office, and deny that they are estopped by virtue of those proceedings to insist that their patent is in force for the full term of seventeen years from the date it was issued.

OPINION OF THE COURT.

RICKS, *J.*: It will be seen from the foregoing statement of facts that the complainants do not deny the proceedings instituted by them in November, 1883, in the Patent Office, substantially as set forth in the defendant's motion. But they contend that they are not bound by the action of the Patent Office, taken upon their petition for several reasons; among these, and chiefly:

First—Because the petition for a limitation upon the duration of their patent, filed by the complainants, and the proceedings in support thereof on their part, were taken under a mistake as to the law, and as to their rights under the patent, and that this error was corrected as soon as possible after discovery.

Second—Because the action and orders of the Patent Office were without authority of law, of no force and validity, and therefore did not in any way effect the patent.

The complainants' statement of the facts under which this action of the Patent Office was invoked admits that they were advised and believed at the time that such action was necessary in order to remove doubts as to the validity of the patent as originally issued. These doubts arose because of a decision of one or more of the federal courts that it was essential to the validity of a patent, where foreign patents for the same invention had been applied for, that the date of such foreign patents and their limitation should be cited in the application, so that the limitation of the American patent would appear on its face. In view of the uncertainties thus existing as to the validity of the Edison patent because of these omissions in the application for the patent, and to remove all doubts, the patentee and the assignee, both joined in a petition to the commissioner of patents in which they stated that while the application for letters patent No. 223,898 was pending said patentee applied for and obtained letters patent for the same invention in several foreign countries as hereinbefore fully set forth in the statement of the case. The petitioners further represented that because of the omissions of such recitals in the application the United States letters patent were granted to the patentee, unlimited, for the full term of seventeen years, The petitioners further say that they were advised that said letters patent, when issued, should have been limited upon their face to the term of the foreign patent having the shortest term prior to the date of the United States patent. Thereupon the petitioners tendered the said United States letters patent to the commissioner of patents, and requested that they be corrected according to the provisions of the first clause of rule 164. Upon this petition, the commissioner issued the following certificate:

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.
WASHINGTON, D. C., Dec. 18, 1883.

In compliance with the request of the party in interest, letters patent No. 223,898, granted January 27, 1880, to Thomas A. Edison, of Menlo Park, N. J., for an improvement in electric lamps, is hereby limited so as to expire at the same time with the patent of the following named having the shortest time to run, viz:

British patent, dated November 10, 1879, No. 4,576; Canadian patent, dated November 17, 1879, No. 10,654; Belgian patent, dated November 29, 1879, No. 49,884; Italian patent, dated December 6, 1879, and French patent, dated January 20, 1880, No. 133 756.

It is hereby certified that the proper entries and corrections have been made in the files and records of the Patent Office.

This amendment is made, that the United States patent may conform to the provisions of section 4,887 of the Revised Statutes.

BENJAMIN BUTTERWORTH,
Commissioner of Patents.

(SEAL.)

Approved:
M. L. JOSLYN,
Acting Secretary of the Interior.

On the sixth day of March, 1893, the complainants, as petitioners, forwarded another application to the commissioner of patents, in which they cited their former petition; the action taken thereon; that subsequent thereto, by decision of the Circuit Court of Appeals of the second circuit, said former action of the commissioner was declared to have been taken without authority of law, and therefore void, and asking that the former correction of the records by the commissioner of patents be cancelled. Thereupon the following action was taken by the commissioner of patents.

"Now, in compliance with the request of the parties in interest, said certificate is hereby cancelled, and the proper entries and corrections have been made in the files and records of the Patent Office.

"In testimony whereof, I have hereunto set my hand,

and caused the seal of the Patent Office to be affixed, this 15th day of March, 1893.

"W. E. SIMONDS,
"Commissioner of Patents.

"(SEAL.)

"Approved:
"CYRUS BUSSEY,
"Asst. Secretary of the Interior."

What is the legal effect of these applications of the petitioner, and the action of the commissioner of patents thereon? It is urged on behalf of the defendant that these proceedings, deliberately taken by the complainants, amounted to a voluntary dedication by them to the public of the patent, from and after November 10, 1893, at which time the British patent expired by limitation. It is contended in reply, that, even though such action was a dedication by the complainants as claimed, it was a dedication of something which was to be given to the public some time in the future, and long before the dedication was to take effect it was revoked and annulled, and no rights thereby passed, either to the defendant or to the public.

Was this conduct and action of the complainants an abandonment of some right, or a dedication to the public of a privilege or right conferred? The arguments on this point have taken a wide range in the briefs of counsel. The action of the complainants in this case, while in the nature of a dedication to the public of a part of the time for which the sole enjoyment of the privileges of the patent were conferred, is not in all respects like the abandonment of a part of an invention by a failure to claim all of it, or by a disclaimer in express words of a part of it. In the latter case, the right of the public to at once appropriate the abandoned or disclaimed part of the invention attaches, and the patentee is powerless to prevent such appropriation. In this case, the complainants did not abandon or disclaim anything that could be immediately appropriated. It was a voluntary act by which they declared a limitation upon the duration of their patent, which shortened its term. It was not, however, as complainants contend, a simple declaration that at the expiration of the shortest foreign patent recited in their petition for correction, they would then dedicate to the public the remainder of its full term of seventeen years, conferred by the United States patent. If its legal effect was such a dedication to take effect ten years in the future, it would have been a gift or grant which might have been subject to revocation. But the time for which the patentee is granted the sole enjoyment of the monopoly conferred is just as much the subject of a dedication and grant to the public as a part of the invention or process. The law on this subject is well "stated in Robinson on Patents," section 345, to be as follows:

"The patent privilege is not a mere reward bestowed upon the inventor for past services, the payment of a debt of gratitude toward one who has already conferred a benefit upon the state; it is also a purchase by the government, acting on behalf of the whole people, of some new art or instrument, capable of beneficial use, for which it recompenses the inventor by securing to him for a time its sole enjoyment; and when, without this recompense, it has obtained the invention through his voluntary act, so far from recognizing him as entitled to remuneration, it unhesitatingly appropriates his invention to itself, whatever loss and difficulty may result to him."

What, then, did the complainants intend to do, and what did they think they had the legal right to do with reference to the legal difficulties which they believed then surrounded them? There can be no doubt as to what their intentions and purposes then were. They asked for the right to limit their United States patent so that it might expire at the same time with the patent named having the shortest time to run. They named in their petition the British patent, No. 4,576, and therein stated that the said patent was dated as of November 10, 1879. They then believed that said patent would expire November 10, 1893, for, if they correctly stated its date, it would by law then expire. The limitation thus deliberately put upon the duration of their own patent was then believed to be necessary to its validity. Acting under such a belief of their legal relations to the public, they then fixed the limit for their patent for what seemed to them a pressing necessity and a sufficient consideration. Whether the patent office was authorized by law or not to make such official correction, the petitioners unquestionably had the legal power to voluntarily fix a limit upon the duration of their own patent.

Did that power depend upon future revelations as to the correctness of the legal advice under which they acted? That their proceedings were taken under a mistake of law might give them the right to correct their error by proper application, made within proper time; but such misapprehension could not affect their power or authority to make such limitation of the grant conferred upon them.

But it is contended that their petition for correction was of such an indefinite character that it put the public and all parties interested upon their inquiry as to its legal effect. It is said that the duration of the patents set forth in the petition were not stated; and to ascertain such a limitation involved investigation as to the laws of the respective countries, and that if such investigation had taken place the defendant would have ascertained that the term of the British patent did not begin until it was sealed and granted.

But the public, and those interested in the duration of the patent had the right to accept complainants' statements as to the date of those foreign patents, and to act accordingly. In their petition for correction they aver that they were not advised that the practice of the Patent Office required an applicant to acknowledge during the pendency of his application a foreign patent applied for and granted subsequent to the filing of such application. The application for the Edison patent was filed November 4, 1879, and the patent was granted January 27, 1880, so that by the admissions of their petition the British patent was both applied for and granted between those dates, and expired between November 10, 1893, and January 27, 1894. The complainants cannot object because the defendant acted upon those representations. If complainants had taken no action whatever, but had relied upon their legal rights as they might be subsequently defined, the public would have acquired no advantages by the proceedings now under consideration. The defendant would have acted at its own peril and have had no claim such as it now asserts. The complainants' conduct and public declaration of the facts concerning their patent are binding upon them, and they cannot now be heard to say that they were made in doubt as to their legal rights, and made in such uncertain terms as to put the defendant upon examination as to the facts and the law, and to be bound by its proper interpretation of them. Even conceding that said petition was filed under mistaken advice as to the law, and that it asked only for such action as the Patent Office might lawfully take, and that the terms in which said action was invoked were such as to put the defendant upon its inquiry as to the law, it was nevertheless a solemn and public act, by which it limited the duration of its own patent to a term shorter than that granted in the original patent. The petition and prayer was for such a limitation, and the complainants are bound by such declaration and conduct. Can there be any doubt as to their right and power to have such a declaration and abandonment of an existing right? Such power is clearly recognized in Insurance Company vs. Mowry, 96 U. S, 547.

But it is said this dedication was revoked. On the sixth of March, 1893, the complainants filed their petition in the Patent Office as hereinbefore stated, and recited further that, by the decision of the Circuit Court of Appeals for the Second circuit, said action of thePatent Office was declared to be "without jurisdiction and wholly void," and for these reasons asking that the records of the Patent Office "be amended so as to cancel the said statements and limitations, and so as to restore them to the same condition in which they were at the time of the original grant of said patent;" and further, "that the said certificate of correction attached to the said letters patent be cancelled so that the patent will be in the same condition in which it was originally granted." Upon this petition, the commissioner of patents, on March 15, 1893, ordered "that said certificate is hereby cancelled and the proper entries and corrections have been made in the files and records of the Patent Office."

By these proceedings it is claimed that if the petition for correction and the proceedings thereunder of November, 1883, amounted to a dedication, such dedication was then revoked, and that the patent stands as though no correction had ever been taken or made.

It is further contended that the holding by the Circuit Court of Appeals for the Second Circuit, that the action of the commissioner on the first petition for correction was wholly void, and that the surrender of the letters patent for correction was without legal authority and of no effect, should be conclusive of this controversy. But this is not a controversy in which the authority of the complainants to surrender their letters patent to the commissioner of patents for correction, or his power to make such correction and amend the records of his office, are involved. The defendant is not here asserting any such power, or claiming any such result as legal or valid. It is here, however, contending that whether the commissioner of patents had legal authority for his action or not the complainants certainly had the right and power to publicly and solemnly limit the duration of their own patent and make record of their intention to abandon it to the public from and after November 10, 1893, the expiration of their British patent. Having done so, and the defendant having in good faith acted on said public declaration, it now contends that the complainants are estopped from coming into court and asserting that such conduct was a mistake as to the law, and therefore not binding upon them. This involves the consideration of the question as to whether the complainants' conduct was a representation as to something it proposed to do in the future, and therefore subject to revocation, or whether it was an abandonment of an existing right. I find the exact question, as it seems to me, fairly settled by the Supreme Court in the case of Insurance Company vs. Mowry, 96 U. S, 547. In that case the court said:

"The only case in which a representation as to the future can be held to be an estoppel is where it relates to an intended abandonment of an existing right, and is made to influence others, and by which they have been induced to act. An estoppel cannot arise from a promise as to future action with respect to a right to be acquired upon an agreement not yet made. The doctrine of estoppel is applied with respect to representations of a party, to prevent their operating as a fraud upon one who has been led to rely upon them. They would have that effect, if a party who, by his statements as to matters of fact, or as to his intended abandonment of existing rights, had designedly induced another to change his conduct or alter his conditions in reliance upon them, could be permitted to deny the truth of his statements, or enforce his rights against his declared intention of abandonment."

But in a later decision the same court said it is not necessary that there should be a design or a purpose to mislead the opposite party on the part of the person to be estopped. In the case of the Leather Manufacturers' Bank vs. Morgan, 117 U. S., 108, the Supreme Court approvingly said:

"In Continental Bank vs. Bank of the Commonwealth, 50 N. Y., 575, it was held not to be always necessary to such an estoppel that there should be an intention upon the part of a person making a declaration, or doing an act to mislead the one who is induced to rely upon it. 'Indeed,' said Folger, J., 'it would limit the rule much within the reason of it if it were restricted to cases where there was an element of fraudulent purpose.' "

Many other cases are cited by counsel, pro and con, which it is not necessary to consider and review. The exact question we have under consideration seems to be met by the foregoing decisions, and are conclusive.

While it is true that the complainants' proceedings in the Patent Office were not had with any reference to the defendant, but had reference solely to their relations to the public, the defendants had, as one of the public, the same right to be influenced and governed by the complainants' conduct as though it had been the result of their representations to each other as individuals or corporations. The complainants, proceedings were a matter of public record. Their acts and conduct were of such notoriety that the defendant, by law, was bound to take notice of them so far as they affected its legal rights under the complainants' patent.

But conceding that there is doubt as to whether the above decisions are conclusive of the controversy, the revocation, which the complainants claim to have made of their dedication to the public was not made until March, 1893, nearly ten years after their voluntary limitation of the term of their patent, as hereinbefore stated. If they were in doubt as to the legality of their conduct in the proceedings in the Patent Office, they should have acted so soon as such mistake was suggested. They could not wait until the public had acted on their dedication, had acquired rights and equities, and then, after the courts had declared their action unauthorized, proceed to revoke their grant.

Did the defendant, in good faith, act upon the complainants' limitation of the life of their patent, and was it induced so to act by the conduct of the complainants, and is it now in such relation to the complainants as estops them from denying that their conduct induced the defendant to make its investments and act as it has set forth in its motion now under consideration?

The circumstances under which the defendant began its enterprise of manufacturing electric incandescent lamps; the different stages in the progress of its development; and the reasons inducing it to increase its capital are fully set forth in its motion, and as hereinbefore recited. Whatever may be the complainants' claim with reference to the defendant's statement of the circumstances under which it originally entered into this enterprise, it seems well established by the affidavits of the defendant's directors that its capital stock was increased and its capacity for manufacturing incandescent lamps greatly enlarged by reason of its belief that the complainants' patent, by their own conduct, was limited so as to expire on the tenth of November, 1893.

This was a very important fact, and the claim that it largely influenced the defendant in its conduct is both reasonable and natural. For the reasons hereinbefore fully considered, it seems to me plain that the complainant is estopped from now claiming that its conduct did not induce such well-defined belief as to the limitation of its patent on the defendant's part. Without deciding how far others, not similarly situated, had the right to rely upon such conduct on the part of the complainants, or without passing upon the question of how far the public generally acquired rights under the complainants' proceedings in the Patent Office, by which they limited the life of their patent, it is sufficient to find, under this motion, that the defendant, by reason of the circumstances particularly set forth in its motion, did rely in good faith upon the complainants' conduct, and had a right to be, and was in fact, influenced thereby.

The application for a dissolution of the injunction is based upon evidence as to a fact which did not exist at the time the temporary injunction was allowed. At the time such application was made, the complainants' patent had not then expired according to the limitation put upon it by its proceedings in the Patent Office. The rule is well settled that on such an application the complainants' rights to an injunction must be clearly established. While it is true that on a motion to dissolve, the burden of proof is on the defendant, yet the rule is equally well settled that evidence which would prevent the allowance of an injunction would be sufficient to dissolve it, and that an injunction will be dissolved on new evidence raising grave doubts as to the complainants' right to the temporary infunction in force. The rule is well expressed by Judge Nixon, in the case of Carey et al. vs. Domestic Spring Bed company et al., 26 Fed. Rep., 138. In that case, the complainants' patent, for the protection of which a temporary injunction was asked, had been sustained by three different circuit courts prior to the filing of the bill in Judge Nixon's district. Upon the strength of these prior adjudications, Judge Nixon ordered the injunction, "without an examination of the merits, or expressing anything upon the validity of the patent." But upon motion to dissolve, new affidavits were offered to showprior use. After an examination of these affidavits, Judge Nixon says:

"It does not appear that such testimony of prior discovery, knowledge and use of the invention was brought to the notice of either of the learned judges who granted the injunction in the other cases. I do not think that I should have seen my way clear to allow the preliminary injunction in the present case if it had been presented on the original motion; and the rule is a good one that the evidence which would prevent the issuing of an injunction ought to be regarded as sufficient to dissolve one already granted."

For the reasons hereinbefore stated, if on the application for the injunction now in force, the facts now relied upon in support of the motion to dissolve had been available as a defense, I would not have allowed a temporary injunction. The complainants' right to such an injunction under such a defense would have been so doubtful that it would not have been entitled to an injunction under the rules cited.

To continue the injunction now, in view of these doubts

would certainly be a great hardship upon the defendant. According to the affidavits now before the court, the defendant is a solvent corporation. Under the Ohio law, the personal liability of the stockholders is an additional indemnity to which the complainants may look in case, upon a final hearing, its right to a permanent injunction should be established.

As the case is now presented on the motion to dissolve, one of the two parties must suffer loss. If the injunction is continued, the defendant is wholly without remedy. It has shown that it was honestly misled by complainants' conduct, and in good faith made additional investments upon the belief so formed. The complainants cannot complain if, for this reason, the benefit of the doubts expressed are given to the defendant and the injunction is dissolved If I am in error as to this conclusion, no great harm can result to the complainants, for if such error is established they can recover for the damages caused thereby, and their right to contest as to other infringers not able to show such meritorious claims to estoppel as defendant has established can be asserted without prejudice from this decision.

The following statement has been issued by the General Electric company. At the time this statement was prepared Judge Rick's opinion had not been received in New York.

The British Edison patent does not in any way limit the term of the American patent. Judge Shipman so decided two weeks ago in the Novak case. The decision of Judge Ricks has not yet been received in the East, but the question before him was this:

In 1883 the Edison company, acting under a mistake and believing that their patent might possibly be invalid unless there was some reference to foreign patents on it, secured from the commissioner of patents a certificate of correction, which was appended to the patent, in which they referred to the foreign patents for the same invention, and stated in substance that the American patent was limited by those foreign patents in accordance with section 4,887 of the Revised Statutes of the United States. By mistake the English patent was named with the other patents. The argument of the Buckeye company, which probably has been accepted by Judge Ricks, was that although the English patent did not in fact limit the term of the American patent, yet the Edison company was not allowed to say at the present time, in the case of the Buckeye company, and under the special circumstances of that case, that its patent did not expire with the English patent, because of the fact that in 1883 this certificate of correction was put upon the patent. The certificate of correction was removed in the Spring of 1893.

The Edison company does not feel that the decision of Judge Ricks will be approved by the courts generally, and proposes to secure a consideration of the point involved by appellate courts at the earliest possible moment.

Electric Headlights in the South.

It is likely that electric headlights will soon come into more extended use on the locomotives of the steam railroads of the country, particularly in the South. It is, of course, conceded that the arc lamps are far more efficient than the old oil lamps, the only question being the economy of installing and operating the electrical apparatus. Writing on this subject in the *Manufacturers' Record* of Baltimore, Receiver W. B. Sparks of the Georgia Southern and Florida road says:

We have eight electric headlights. They cost about $375 each in place on the locomotive. The cost of maintenance is not greater than the oil light. An old headlight will not throw its light on a very dark night more than 150 feet, and it is impossible for an engineer to slow up his train in that distance, even with an emergency brake. The electric light throws its light from a half to three-quarters of a mile. Obstructions can be easily seen at that distance, and some of our engineers claim that a switch disk can be more easily detected by it at night than in the daytime. These lights do away with switch lights, which is quite a saving to roads that use them to any great extent.

Railroads such as ours, running through the pine lands of the South, kill a great many cows. During the rainy season the lands along the line of road become very wet; in places they are entirely covered with water, and the cattle come upon the track seeking some dry spot on which to sleep. We have killed, when we used the old headlight, as many as thirteen at one time, and our claims for stock killed per month have sometimes amounted to over $1,000. The engines using the electric headlight have never killed a cow, and I am confident that the saving in stock claims alone will more than pay for the lights within the next two years.

To this the *Railroad Age* adds the following comment:

As a further illustration of some of the difficulties met by our southern friends it may be stated that in a recent case in Alabama (12 Southern Reporter, 801) the judge decided that trains must be run at night at such a speed that cattle can be seen soon enough to prevent running over them, which would seem to make it compulsory in Alabama that some light must be provided which will render dark objects visible at a greater distance than 150 or 300 feet, or fast trains must be taken off.

A special joint committee of five aldermen and three councilmen has been appointed by the presidents of both bodies at Buffalo, N. Y., to thoroughly investigate the question of municipal lighting, with special reference to city ownership of lighting plants and the advantages that might accrue to Buffalo therefrom.

Corliss Compound Engines for Electric Light Work.[1]

By E. L. Debell.

The question of the utility of slow-speed Corliss engines for electric light work has been discussed at length among those interested in the subject, and a unanimous verdict has apparently not yet been arrived at. It is claimed by some that their motion is not steady enough for the work, while others believe they are suited for arc lighting, but not for the more sensitive incandescent lamp. Without attempting comparisons with other types, the writer will endeavor to give the conclusions arrived at from their use in the plant at Sheboygan, leaving such of you as are interested to compare them with results or knowledge obtained of the other types.

In our plant we have been running steadily for the past fifteen months a Corliss cross, compound 24 by 48 high pressure cylinder; two 46 inches diameter low pressure; speed 74 revolutions per minute; rated capacity about 650 horse power. We use a syphon condenser, supplied by a duplex pump with two 18 inch steam and two 12 inch water cylinders, 12 inch stroke. We carry constantly 25 inches of vacuum, which, however, can be readily increased to 28 inches should the load be very heavy. When the load is light we consider it the best practice to keep it at 25 inches and reduce the steam pressure.

A good Corliss engine of this size and type should handle its rated economical load on 18 pounds of water evaporated per horse power hour, and within a range of 20 per cent. above or below that point, or not over ½ pound additional. With good boilers properly fired and allowing 7¼ pounds of water evaporated per pound of coal, this would equal 2 4-10 pounds of coal per horse power hour.

It should be borne in mind at this point that, while the first cost is higher for an engine capable of running on the least coal, it is really cheaper in the end, as less investment is required for boilers, and the saving in coal continues for all time.

The first cost of the Corliss engine may be placed at one-third more than an equally well-made one of the high speed type, and it takes up about one-third more room. Its life, however, is generally conceded to be 50 per cent. longer, on account of larger wearing surface and slow speed. The greater bulk is usually of no serious moment, except where space is restricted or valuable.

The cost of attendance and oil and waste is practically the same as on any other good engine, while the cost of and the facility of making repairs seems to be in their favor. The latter feature is particularly true of the cross-compound, as the valves and valve gears can be readily overhauled in either cylinder without disturbing the other. As the proper care and adjustment of these parts is of great importance in the economical working of the engine, it is quite an advantage to be able to complete ordinary examinations and repairs in a few hours' time.

In the tandem compound, one cylinder being directly back of the other, the pistons and heads have to be removed from both to get at the cylinder next the engine frame. In an engine the size of ours it would be practically impossible to do this and make repairs between shutting down and starting time, which is a serious matter in plants depending upon one engine.

The cross-compound being connected to both ends of the shaft divides the wear between two sets of cranks, crossheads and bearings, while the tandem being connected to one end only the wear falls all on one set.

The two cylinders of the cross-compound are connected to the shaft one-quarter turn apart, or in other words, one is exerting full force when the other is on the center, thus helping to keep the motion regular and steady.

Another feature of the Corliss engine is that trouble usually develops slowly, in most cases giving warning of its existence in time to permit of the proper remedy before it becomes serious, sometimes saving a shut down of more or less duration.

The selection of proper sizes is a very important consideration, as the addition of an extra cylinder reduces the range of economy.

The load in nearly every electric light plant is so variable that one engine cannot do the work profitably, and it is probable that in most cases three engines of one size will give the best results. They should be large enough so that one will handle the light load, two of them the heavy load leaving one always in reserve. This gives an economical size for all the varying loads, and practically duplicates the plant with a minimum expenditure in idle machinery.

The cost of three engines will not be very much greater than the same capacity in one or two engines, and some less boiler capacity will be required. As to close regulation and steady motion, no trouble should be had on this score, if the power machinery is properly installed and managed, and the engines worked within their economical range.

We are able to furnish a good light with our Corliss engine, and it is so regarded by our customers. At any time it is found otherwise the trouble is soon traced to some fault in operation and readily subdued. The conclusion we have arrived at, is that these engines are well adapted for our work, economical in the use of fuel, durable and easy of repair. The proper appliances should be used both in the engine and boiler rooms, to ascertain if the benefits paid for are being secured, and if not where the leak is. If more fuel is being consumed than seems necessary, examine the engines and if they are working properly ascertain how much coal the boilers are consuming per pound of water evaporated. The trouble will most likely be found in one of these quarters, and when remedied good results will surely follow.

1. Read before the Northwestern Electrical association, Milwaukee, January 18, 1894.

An Interesting Fire Alarm Installation.

Ex-Vice-president Morton has just closed a contract through his architect with an electric heat alarm company for providing an automatic fire alarm system for his barn at Rhinecliff-on-the-Hudson. It is the purpose of Mr Morton that should the barn catch on fire the cattle can be released by electricity, and the barn doors thrown open by the same means. The system of wiring will be duplicated so that should one set of the negative and positive wires be cut there would still be an alarm in case of fire. On the front of the barn will be a ten-inch vibrating bell and at the office, 150 feet from the barn, there will be a seven-inch bell to ring continuously in case of fire. On the outside of the office will be an annunciator announcing the location of the fire in either basement north, basement south, first floor and loft north, first floor and loft south and L. In the office will be placed the testing and recording apparatus, by which, with the a turn of the hand, all the wires will be tested and a record made of the day of the week. Thus it can be seen at a glance any time during the year whether this test has been made or not. The barn will also be fitted with four station watchmen's clocks. The clock in the office and stations in the barn, also the wires for the above apparatus, will be placed underground from the office to the barn. The system used will be that of the Electric Heat Alarm company, South Boston.

Electricity in Insurance Matters.

The second report of the committee on fires of the Underwriters' International Electric association has been issued by William H. Merrill, Jr., of the Chicago Fire Underwriters' association. It shows that since the last report, issued November 20, 1893, 77 fires have been caused by electricity, of which a record had been made—a slight decrease. Actions are reported as follows: By the Philadelphia Fire Underwriters association, a demand for guard wires and hand switches along the routes of trolley roads; by the New Hampshire Board of Fire Underwriters, the adoption of provisional rules to govern cooking and heating circuits and apparatus, awaiting the action of the Underwriters International Electric association; by the city electrical inspection department of Chicago, the adoption of the rules and regulations for electric light and power wiring recommended by the Underwriters' International Electric association.

COMMUNICATION.

Institute Branch Meetings.

To the Editor of the Western Electrician:

In your issue of January 13th, I observe an editorial on the question of "branch meetings" of the American Institute of Electrical Engineers, the purport of which I do not understand. No one in his senses would question the right of Chicago or any other place to have one or any desired number of independent electrical societies, and yet this question seems to be implied in your editorial. So far as I have been able to acquaint myself with the facts of the case it is precicely because the Chicago electricians were not satisfied with local societies that they asked for local meetings of the Institute.

The American Institute of Electrical Engineers originated in New York, and has ever since had its headquarters in New York, and there the headquarters should remain until it can be shown that the best interests of the profession can be promoted by moving them elsewhere. I do not think that there is any complaint from the citizens of the Pacific Coast states that their federal legislation is made for them at Washington, D. C., on the Atlantic seaboard.

It is true that years ago some enthusiasts wanted the national capital moved to the geographical center of the national territory, but the reasons for so doing have never impressed the mass of the people as cogent.

As the electrical professor needs a truly national society, and as the American Institute of Electrical Engineers has filled the bill pretty well so far, and as no other society has made even an attempt to do the same it behooves those who are interested in the welfare of the profession to assist the Institute to be useful—to be national. It is absolutely necessary that there should be a council or similar body at the headquarters, just as we have an executive department at Washington, D. C., and if they do not work the popular will our remedy is at the annual election. Out of a membership of about seven hundred and fifty there are less than two hundred in New York city. On the other hand there is no other city which has anything like one hundred members; in fact no other city has even fifty members unless it be very lately, and there are a great many members in the immediate vicinity of New York. It was a Chicago member who told me last summer that he did not expect to get as large a membership in Chicago in proportion to the population as in New York, for the simple reason that the electrictians are not so plentiful in Chicago. This opinion certainly could not have been biased by sectional feeling. It was remarked at the last meeting that the Institute was not responsible for the geographical distribution of the cities of the Union, but on the other hand the

Institute should use its best endeavors to extend its privileges to the most distant member so far as practicable under existing conditions.

As citizens of the United States the members of the Institute have a right to peaceably assemble when and where they choose, and among other things to discuss the Institute papers. This right cannot be disputed. But further than this, the members who propose to meet at other points than the headquarters of the Institute want some official recognition by the Institute of such meetings and corporation in carrying out the necessary managements therefor.

It is entirely unreasonable to expect that the Institute can officially recognize any papers except those which have been regularly accepted, as the standing of the Institute depends upon the character of its papers and the value of the Institute to the individual members depends upon its standing before the world. There need be no fear that any worthy paper will be excluded if presented in the regular way. There has never been such a case yet, and what fault there has been is of the opposite kind; that is some papers have crept in which ought to have been kept out. I think that the Institute is agreed that we ought to do what we can for the distant members, and whatever difference of opinion there may be is on the question of what we can do and how we ought to do it.

This, however, may prove to be an important difference of opinion, but it is to be hoped that the subject will be treated in a national and not a local spirit by all concerned. Hoping for the co-operation of the WESTERN ELECTRICIAN in the good work, I remain, yours respectfully,

TOWNSEND WOLCOTT.

New York, January 22, 1894.

Prof. Thomson's Plans.

A number of newspapers have given publicity to a report, sent out from Boston, that Prof. Elihu Thomson, dissatisfied with the management of the General Electric company, was about to retire from it and, with others, organize a rival company. The rumor was to the effect that Prof. Thomson had, in fact, declared war upon the General Electric company and proposed to be one of a number of the original Thomson-Houston people to form a new corporation to manufacture under his patents, his aim being also to regain possession of the big West Lynn plant for a workshop. Eighteen months ago nearly 4,000 men were employed in this plant; the working force at present is about 500. Prof. Thomson was said to have asserted that he never sold his arc lamp to the General Electric company and that he had a new incandescent lamp. It was admitted that he was under contract by the terms of the consolidation to offer his patents first to the General Electric company, but Prof. Thomson was reported to have alleged that he was freed from this obligation by repeated breaches of contract on the part of the company.

The WESTERN ELECTRICIAN is enabled to state, however, on the best authority, that the rumor is groundless, Prof. Thomson totally repudiating the plans attributed to him.

Provincial New York.

From the New York Sun.

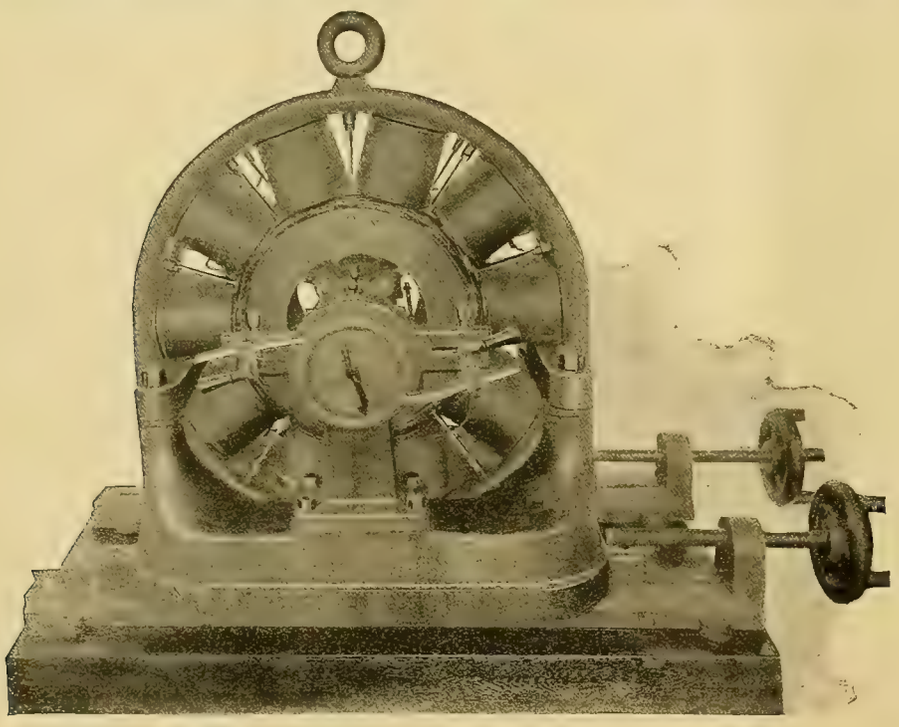
The trolley has become so much a matter of course in Brooklyn that Brooklynites profess to feel as if they had got into the country when they come over to New York and ride behind horses. They say it seems like a return to primitive conditions.

New Alternating Dynamo.

In the accompanying illustration is shown the new Bain alternating dynamo. The general lines of alternating dynamos have been followed in the construction of this machine, special attention having been paid to important details which make the apparatus highly efficient. The center of gravity is particularly low, which prevents vibration and insures steadiness of running. The regulation is so adjusted that it can be over-compounded to any degree in a few moments, even while the machine is at full speed. This is accomplished by an ingenious arrangement whereby the strength of the field is automatically adjusted though the exciter. This gives close regulation, and one that can be relied upon to adapt itself to ordinary conditions of practice. The armature coils are wound of copper ribbon, so arranged that they can be easily replaced. This dynamo is placed upon the market by the Great Western Manufacturing company, Chicago.

Test of the Hydraulic Tunnel at Niagara Falls.

The first practical test of the hydraulic tunnel at Niagara Falls was made January 25th in the presence of the officials of the Niagara Falls Paper Mill company and of the Philadelphia company which built and placed the machinery in position and Prof. Geyelieu, the designer of the turbines used. The water drove one of the three turbines from 11 A. M until 1 o'clock, then the second was put in operation, and the third at 2 P. M. The test was considered successful by those present and now there remains only the formal opening of the power house and the starting of the electrical machinery. This opening, it is intended, shall take place on June 1st.



NEW ALTERNATING DYNAMO.

National Electric Light Association.

C. O. Baker, Jr., master of transportation for the National Electric Light association, announces that the Boston Passenger committee and the Southern Passenger association have granted a rate of a fare and a third for the round trip from points in their respective territories to members and delegates attending the Washington convention. It is expected that similar action will be taken by the other passenger associations.

Secretary Porter has issued a circular to central station managers inviting them to attend the convention and participate in the discussions. The list of subjects to be considered was presented in the WESTERN ELECTRICIAN January 13th. It is announced that a paper entitled "Electric Lighting at the World's Fair and Some of its Lessons," illustrated with stereopticon views, will be presented by T. C. Martin and L. Stieringer. Other special features include a paper on "Impressions of a Central Station Man Abroad," by E. A. Leslie, and another on "The Importance of Complete Metallic Circuits for Electric Railways," by J. H. Vail.

A permanent injunction has been granted in Akron, O., restraining the Thomson-Houston interests from building a line on Furnace street.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 29.—Mayor Schieren of Brooklyn has taken under consideration the complaints made of the alleged dangerous speed at which the trolley cars are being run. Subway Commissioner George W. Plympton, who has also been investigating the subject, sent a communication to the mayor, embodying a number of measurements made upon lengths of 200 feet in each case, and in no case involving a street crossing. The results show that the limit of speed assigned by municipal regulation is frequently exceeded on the trolley lines. In speaking on the subject the mayor says: "I believe it would be a good idea to have inspectors patrol the streets on which trolley cars are run, whose duty it should be to arrest motormen who indulge in reckless running. I have laid the scheme before the board of subway commissioners, and it is now considering it. I am in favor of fixing a maximum rate of speed for the cars which shall not menace the lives of the people. The question is too important to be disposed of hastily, but when I get ready to act I will present my views to the aldermen." President Norton of the Atlantic avenue system discusses the question in an interesting and unique light. He says that he thinks every person who gets run over by a trolley car ought to be arrested. He says that is the way they do in Berlin, and he thinks the custom a good one. He does not think the motormen who kill human beings should be arrested. People are usually killed because of their own carelessness.

The results of this agitation on the speed of trolley cars in Brooklyn were manifested in a meeting in the mayor's office last Tuesday, at which the question of the speed of the city's trolley cars and their running was discussed. There were present the representatives of all the principal lines, a couple of representatives from the employes' union and two experts, members of the subway commission, of whom Prof. Plympton was one. Reports were made as to he speed of the cars, which, as timed, was not excessive in the busier and more crowded parts of the city. But when an explanation was asked by the mayor of accidents which have occured a singular conflict of testimony between the officers of the car companies and their employes was developed. The latter said that they were required to make a round trip on time; that the time lost in the crowded streets had to be made up where the streets were more free, and if it was not so made up the motormen were made to suffer. This was denied by the officers of the company, who made the statement that the motormen were to blame, as they run their cars beyond the legal speed and in a reckless manner. Here is a curious conflict of statement. The power of disciplining the motormen possessed by the companies' officers is very great. It is, indeed, practically unlimited. To assert that they cannot check their employes in running the cars too fast is to say something incomprehensible. The statement of the employes, on the other hand, is in accord with what might he expected. There certainly is a time-table which fixes the limit of a round trip. There is also a requirement that round trips shall be made within the time so fixed. If the necessity of a slow rate in crowded parts of the route is accepted as a valid excuse for failing to complete the round trip in schedule time, it must be easy to prove that fact; but mere assertion does not prove it. And the assumption is assuredly very violent that the companies are at the mercy of their motormen and cannot prevent them from running the cars at excessive speed. It is certainly not reasonable to believe that the motormen like to incur the risk of killing or maiming people out of pure enjoyment of great speed for the cars.

The mayor desired the representatives of the companies to agree upon a proper ordinance covering the matter, as the one drawn up last summer was never adopted. Police Superintendent Campbell has issued an order to the police force calling attention to the need of observing the rate of speed of the trolley cars.

A revolution in the manner of distributing Wall street news is promised by the adoption of an electric printing machine by the Kiernan news agency. It is proposed to place the machine in offices and public places and send the news by wire directly to the customers, the machine printing it much in the same manner as a typewriter. If the system proves a success, it will do away with the slower method of messenger service now in vogue.

Ex-Judge George M. Van Hoesen, on January 27th, in the Supreme Court, before Justice Barrett, made an application for the appointment of a receiver of the Thomson-Houston Electric company of this city, in a suit which has just been brought by the Holland Trust company, as the trustee of the bondholders, for $600,000, to foreclose a mortgage for

that amount made by the electric company. The interest on the mortgage, which became due last September, and amounts to about $18,000, has not been paid. The Thomson-Houston company was put in the hands of a receiver several days ago, Henry Winthrop Gray being appointed by the court, and it was asked that the same receiver should be appointed in this proceeding. Justice Barrett intimated that he would appoint Mr. Gray also in this case. On behalf of the receiver, Mr. Gray, it was asked that he be given permission to issue receiver's certificates to the amount of $3,600 for the purpose of securing funds to pay the water rent, now due, which the city threatens to cut off at any moment, and also to pay other indebtedness in filling contracts with customers to whom the company is liable. After some discussion on this matter, Justice Barrett allowed the motion to stand until next week, in order that all the creditors may come in and be heard.

Last Tuesday the members of the rapid transit commission met in secret session, presumably to discuss and take action upon the proposition made by banker Wilson on behalf of the syndicate which he represents and which proposes to make an effort to furnish New York with rapid transit by constructing an underground system and operating it by electricity.

As far as it has gone, this has been the most satisfactory agitation yet raised to remedy the existing lack of rapid and reliable transportation within the city. The lack of interest shown in the elevated plan recently proposed by Mr. Bushe and the evident objections to it argue strongly in favor of underground transit. That the gentlemen represented by Mr. Wilson are confident that a road constructed practically upon the same plan as that adopted by the commission two years ago can be built is shown by their offer, and the fact that they will forfeit $1,000,000 if they fail to comply with the conditions which they urge the commission to accept. The only trouble with the Wilson proposition at present is that there is a constitutional bar to a loan on municipal credit to a private corporation, and many express themselves as doubtful whether this should be removed to meet a particular exigency. If it be admitted that it ought to be, it is still a question whether it would be. A delay would be experienced until next summer to find out whether the constitutional convention would assent to its removal, and if it should do so, the promoters would have to wait until near the end of the year to know whether the convention's action was ratified by the people.

It is said that the commission has given its assent to the plan as outlined by Mr. Wilson, and which was published in full in the last issue of this journal. The commission will hold a public meeting tomorrow and it is hoped that at that time the prevailing opinion among its members may be made known and some idea gained of the prospects of rapid transit in this city. W. F. O.

PERSONAL.

S. G. Coleman, superintendent of the Badger Illuminating company, Milwaukee, Wis., was in Chicago last week.

Much regret is felt at the death of Prof. Heinrich Hertz at the early age of thirty-seven. Dr. Hertz, who died at Bonn on January 1st, was considered to rank only second to von Helmholtz as Germany's greatest physicist. His investigations into the laws of electricity, especially as related to those of light, gave him a world-wide reputation.

On Friday, January 19th, the Hon. George B. Shaw of Eau Claire, Wis., made an interesting address in the House of Representatives on the Wilson tariff bill. It was a carefully prepared argument, and, being Mr. Shaw's first speech in the house, attracted considerable attention and much favorable comment. Mr. Shaw's numerous friends in the electrical fraternity predict for him a brilliant career at Washington.

F. S. Terry has severed his connection with the Ansonia Electric company, and hereafter will devote his entire attention to the Sunbeam Lamp Manufacturing company of which he is secretary. Mr. Terry was identified with the Electrical Supply company from the time of its formation, and in 1884 established the Chicago branch of that concern. Mr. Terry has a reputation as a successful business man, and his wide acquaintance and experience will prove valuable to the Sunbeam company, which is to be congratulated upon effecting such a desirable arrangement.

NEW INCORPORATIONS.

Electrical Power company, Sterling, Mo.; capital stock, $10,000; to maintain an electric light plant at Sterling; W. T. Stout, Sterling, Mo.

ELECTRIC LIGHTING.

Hollow Rock, Tenn., is to have an electric lighting plant.

A fly wheel in the Manufacturers' Electric Light company's station at Philadelphia burst on January 17th, killing a passerby and causing much damage to the plant and buildings in the vicinity.

It is announced that Kalamazoo, Mich., will put in an electric light plant to cost $45,000.

The contract for the erection of an electric lighting plant at Napoleon, O., has been let to a Minneapolis firm. Work will be commenced at once.

The Jamestown, N. Y., Electric Light & Power company has made a new proposition to furnish arc and incandescent lights for street illumination.

Owing to a misunderstanding between the council of Ada, O., and the Ada Electric Light company, the electric lights have been removed, and the town is in darkness.

A central electric lighting station has been established and put in operation at Boen-sur-Lignon, France. The electric lighting question is also being considered at Roubaix.

It is reported that a Chicago syndicate is endeavoring to secure a franchise for the operation of gas and electric light works at Antioch, Ill. Antioch is in Lake county, Ill., and is on the Fox River, about 52 miles northwest of Chicago.

The Waterloo, N. Y., Electric Light company has submitted a proposition to light the streets for a term of five years, with not less than 50 arc lamps of 2,000 candle power, on the basis of the moonlight schedule, each arc to be paid for at the rate of $60 per annum.

Marion, O., is in total darkness. The council refused to contract with the electric light company on terms offered, whereupon the company turned off all the lights. Under the old contract the city paid $78 per light for 1,700 hours. The price refused is $100 per light for 4,000 hours.

The Buffalo General Electric company has handed in a proposition to build a new electric plant on a large scale on its property at the junction of Wilkeson and Seventh streets, on condition that it be allowed to make water connections with the Erie canal to be used for condensing purposes. This work will give employment to a large number of men in the near future. The request was granted.

ELECTRIC RAILWAYS.

The Waukegan, Ill., Electric Railway company has petitioned for an extensive franchise in the town of Waukegan.

Fire destroyed the Willson avenue car barns of the Cleveland Electric Railway company last month. Eighteen motor cars and 12 trailers were burned. The loss is estimated at $60,000.

The reserve power house and machinery and car sheds of the Savannah, Ga., Electric Railway company were burned January 18th. The loss is estimated at $50,000, partially covered by insurance. The fire is supposed to have been the work of an incendiary.

The grand jury has returned 110 indictments against the officials of the Youngstown, O., Electric Street Railway company for failing to comply with the law requiring vestibules on each motor car to protect the motormen. The penalty in each case is a fine of from $25 to $100.

William T. Dulany of 280 Broadway, New York, has devised a system of operating street railway cars by a trolley on the underground plan, and has applied to the authorities in Brooklyn for permission to lay underground wires for a distance of one mile, where he will give a public exhibition of his invention.

Japanese capitalists are discussing the advisability of constructing several important suburban railway lines in the vicinity of Tokyo, which, if built, are likely to be electrically operated. It is proposed to build roads between Shinbashi and Shinagawa, and from Hatchobori to Yeitai Bridge via Yori. The total length of the projected lines is roughly estimated at forty miles, with double tracks in several localities. The capital proposed is equivalent to $1,000,000, of which one-half will be subscribed by the projectors.

TRADE NEWS.

On Wednesday, January 17th, the delegates to the convention of the Ohio Society of Civil Engineers and Surveyors visited the correspondence school of technology at Cleveland, O., recently established by E. P. Roberts.

The Shultz Belting company of St. Louis, Mo., has just received an order from England for 2,800 feet of belting and an order from Russia for 15,000 feet of belting. The company reports that trade is looking up and orders are coming in freely, and the outlook for business is fair.

It is announced that H. B. Morgan, formerly with the Munson Belting company, has formed a connection with the Graton & Knight Manufacturing company of Worcester, Mass., which has opened a Chicago store at 173 South Canal street. Mr. Morgan says that a special feature will be made of dynamo belts, and he expects to secure a fair share of the business.

Catalogue No. 3 of the R. Thomas & Sons' company, manufacturer of hard vitreous porcelain electrical supplies, East Liverpool, O., is an attractive compilation of reproductions of the numerous specialties handled by this company. The book is a large one and the illustrations are excellent lithographs in two colors, bringing out in a satisfactory manner the points to which it is desired to attract attention.

"Points on Perforated Electric Belting," a catalogue and book of general information on patent, perforated, electric leather belting for electric railways and electric lighting, is being sent to the trade by Chas. A. Schieren & Co., New York. There are many points of interest and subjects for consideration in this type of belting, and this book touches upon them all, beside containing many tables and computations of value.

The Arkansas Electric Supply company, Little Rock, Ark., gives practical points on electric lighting in a neat folder which it is giving to the trade. For such a small book it contains a surprising amount of practical information and, of course, it shows how advantageously the company may be consulted upon all questions of electrical supplies, of which it carries a large line. The company is in the market with a telephone, which it sells outright, and which is well adapted for private lines.

Eugene Munsell & Co., importers, miners and wholesale dealers, 218 Water street, New York, are sending to the trade a catalogue and samples of stamped, solid sheet India mica. The firm, having its presses and dies ready, is prepared to furnish mica, stamped to exact pattern from the solid sheet, for street car motors, rheostats and other purposes. Purchasing mica in this form has advantages over the old method. The firm carries at all times a large stock of selected electrical, cut and sheet mica, of all qualities.

The American Battery company, Chicago, has issued a most interesting little book on its type of storage batteries. In it are reprinted the paper read before the street railway convention at Milwaukee by C. O. Mailloux on the storage battery in central station work and the paper read before the American Institute of Electrical Engineers, by A. H. Bauer on the applicability of storage batteries in train lighting. Attention is also paid to storage batteries in all their forms of usefulness, such as for traction work, running motors, yacht lighting and the numerous other applications for which they are adapted.

Circular and price list No. 3, issued by the Weston Electrical Instrument company, Newark, N. J., treats of the Weston standard, portable, direct-reading voltmeter for alternating and direct current circuits. Some of the specific advantages claimed for this instrument are that they are direct-reading, portable, dead-beat if properly used, possessed of no magnetic lag or any appreciable error due to self-induction, with the exception of the lowest ranges, and that the influences of temperatures are easily corrected by means of a temperature regulator. The catalogue contains full information respecting styles and hints to purchasers.

The Brown Telephone & Telegraph company, Chicago, evidently intends that its customers shall know all about the telephone litigation and the situation at present, for it has issued a small book containing legal opinion as to the rights of the company regarding infringement of the existing patents of the American Bell Telephone company, given by Charles C. Bulkley and Lysander Hill, Chicago. The little work is an interesting one and very pertinent at this time. The Brown telephone is a magneto-phone, and is sharply differentiated from all other telephones of its type by the employment of repulsive magnetism. The manner in which this principle is employed is Brown's invention and is secured to him and his assignees exclusively by letters patent of the United States.

BUSINESS.

The Star Electric Lamp company, Chicago, manufacturer of the Sunbeam lamp, has changed its name to the Sunbeam Lamp Manufacturing company. The policy of this company is to furnish lamps of superior quality.

The Detroit Motor company will furnish the dynamos, switchboard and wiring for the electric light plant of the Home Savings Bank company, Detroit, Mich. The wiring will be Okonite and interior conduit and the engines will be Ideal. E. P. Roberts of Cleveland prepared the specifications.

The Electrical Engineering company, 249 Second avenue and avenue S, Minneapolis, Minn., has issued a discount sheet dated January 20, 1894, for its catalogue No. 2. A glance at this sheet shows not only the large stock the company carries, but that it intends by fair prices to retain its present position in the electrical field.

The Arkansas Electric Supply company, Little Rock, Ark., has secured the contract for installing an electric lighting plant at Searcy, Ark. The company wishes quotations on new and second-hand 750 light alternators, with transformers and incandescent street light fixtures, and a 75 horse power, high speed, automatic engine.

One of the oldest and best known commutator conservers on the market is that being sold by the Central Electric company, Chicago, and known to the trade as "Gale's." The company states that this conserver has been largely used by central station men for the last five years, and that the demand for this article is steadily increasing.

The Great Western Manufacturing company, Chicago, during the last thirty days has sold many important orders, among them being alternators of 600 lights capacity in Ladd, Ill., Manselona, Mich., Reed City, Mich., Fond du Lac, Wis., and Cripple Creek, Colo. The company has been equally successful in the sale of its other types of apparatus.

Campbell & Zell, engineers and moulders, Baltimore, Md., are extending their plant and greatly increasing their facilities for turning out their high class of goods. George P. Flinn, manager of the sales department, announces that the firm is in the market for machinery, including planers, lathes, drills, boring mills and accompanying

apparatus. The machines must be new, or, if second hand, in the best of condition.

The Viaduct Manufacturing company, Baltimore, Md., is completely equipped with every facility for successfully competing in the anticipated increasing telephone business. It is carrying in stock a full line of everything required in connection with the telephone business, such as switchboards, telephone cords, magneto and extension bells, etc. The instrument handled by this company is of the magneto type and is manufactured in several different styles for use in all places where telephonic communication is desirable.

The American Electrical Manufacturing company of St. Louis, considering it inadvisable to reduce the prices of its high-grade lamps, and, as it cannot do so without using somewhat cheaper materials, and thus place itself open to the imputation of reducing the quality, it has determined to maintain the quality of the American lamp, using material, as heretofore. To meet the demands of many, the company is now manufacturing a lower priced lamp called the Republic, which differs from the American only in the use of some materials less costly, without reducing materially the quality. These are not presented as a cheap article. The Republic lamps are rated at 600, and the American at 1,000 hours average life. A large increase has been made in the capacity of the factory to meet the demands for both lamps, and the company is already in receipt of numerous large orders for the new Republic lamps, beside the regular orders for the American.

McDougall, Lucus & Co. is the name of a new firm which began business as manufacturers' agent for central station specialties in Chicago a short time ago. Although the firm name is a new one, the names of the gentlemen associated with it are well known to the electrical trade. Mr. McDougall was at one time the head of the firm of McDougall & Cummings, which represented the Electrical Construction & Supply company of New York for many years. H. P. Lucas has a wide experience and acquaintance, and his familiarity with the electrical trade will doubtless be of much benefit to the new firm. The arrangements of the firm have not as yet been fully completed, but it has already secured the sole rights of the F. P. Little Electrical Construction & Supply company, Buffalo, N. Y., to sell that company's arc lamps west of Buffalo and Pittsburg. The firm is also manufacturing the Climax iron-clad rheostat and motor starting boxes and special resistances in this line.

Andrews & Haschke, Chicago, are now completing one of the lightest most durable and efficient storage batteries on the market. They are making a cell for portable phonograph use, which stands about 11 inches high, 5 by 6 wide and weighs a trifle over 30 pounds. It has a capacity of 175 ampere hours. A point of merit possessed by this battery is that it has a great amount of plate surface exposed for chemical action, and the plates are separated with an improved insulation, which is electrochemically saturated with their improved magnet winding insulation, which keeps the cell from buckling and makes a low internal resistance. The battery is constructed to receive rough handling. It will be ready for the market in about two weeks; all sizes will be made to order. The firm is also making a strong bid in the field of armature winding, using an improved insulation, which it claims will prevent the burning out of armatures and field coils. A specialty is also made of recharging and repairing storage batteries of all systems.

The General Electric company has secured a large portion of the street railway car equipment contracts awarded during the last ten days in Philadelphia. Of 250 contracted for by the Peoples' Traction company 125 equipments with the G. E. 800 motors and type K controllers were purchased of the General Electric company, while the remaining 125 were allotted to the Sperry company of Cleveland. Of 80 equipments required by the Electric Traction company of Philadelphia, 70 will be furnished by the General Electric company. The Peoples' Traction company had already contracted for three of the great 1,500 kilowatt General Electric generators. The General Electric company has also secured contracts during the past week covering 25 car equipments for the Union railway company of New York, 20 car equipments for the Steinway Railroad company, Long Island, one 700 horse power generator for the Steinway Railroad company, Long Island, eight multipolar, 300 kilowatts generators for Cincinnati, O., and 10 car equipments for the St. Louis Street Railway company, St. Louis, Mo.

ELECTRICAL PATENTS.

Issued January 16 and 23, 1894.

512,687. Electrical Limiting Time Interval Clamp or Brake. Allan W. Dow, New York, and Thomas R. Griffith, Brooklyn, N. Y.

512,706. Apparatus for Electrolytically Treating Raw Hides. Paul R. de F. d'Humy, Chicago, Ill.

512,711. Rail Bond Connector for Electric Railways. Herbert R. Keithley, Chicago, Ill.

512,723. Electric Inhaler. Reubin L. Larcom, Fandon, Ill.

512,757. Process for Making Secondary Battery Plates. William L. Silvey, Dayton, O.

512,769. Machine for Winding Electro-magnets. Richard Varley, Jr., Englewood, N. J.

512,774. Electric Switch. Ernest P. Warner, Chicago, Ill.

512,797. Electric Heater. William J. Bowen, Norwalk, O.

512,805. Switchboard. William A. Childs, Englewood, N. J.

The invention relates to switchboards equipped with flexible cord conductors or cords fixed at one end, with a weight and pulley over which the cord passes for returning the cord and plug to their normal position by gravity. The cord is attached to a removable block forming a part of the face of the board and held in place in the frame by friction. By lifting the block the entire cord, plug and weight may be removed.

512,820. Motor-generator. John C. Henry, Westfield, N. J.

The motor-generator is provided with two separate armatures upon a common shaft provided with a bearing between the armatures, the pole pieces of the two armatures being excited by the same field coils.

512,821. Ceiling Fan Motor. William Hochhausen, Brooklyn, N. Y.

512,843. Dynamo-electric Machine or Motor. Howard S. Rodgers, Hartford, Conn.

512,853. Commutator and Connection for Dynamos. Gilbert Wilkes, Detroit, Mich.

512,872. Sextuplex Telegraph. Thomas A. Edison, Menlo Park, N. J.

The telegraph is adapted to transmit simultaneously three messages in each direction, and comprises a reversing key with two transmitters and their batteries, whereby one transmitter places to line currents of greatest strength and the other transmitter those of least strength, and the second transmitter when closed lessens the currents put to line by the first, and the first increases the currents put to line by the latter transmitter.

512,880. Electric Arc Lamp. Charles J. Hartley, Decatur, Ill.

512,888. Trolley Wire Insulator. Henry H. Luscomb, Hartford, Conn.

512,907. Battery System for Electric Railways. Leslie B. Rowley, Ashland, Wis.

512,923. Electric Railway Trolley. Walter Van Benthuysen, New Orleans, La.

512,962. Excitant for Voltaic Cells. Gardner Hewett, New York, N. Y.

512,970. Electric Washing Machine. John P. Johanson, New York, N. Y.

513,006. Continuous Electric Current Distributing System. Michael von Dolivo-Dobrowolsky, Berlin, Germany.

513,023. Electric Railway Trolley. George W. Mackenzie, Beaver, Pa.

The trolley comprises two cone-shaped rollers rotating about vertical axes, the conductor adapted to engage the rollers between their peripheries.

513,051. Apparatus to Control the Strokes of Piston Rods Electrically. Charles E. Ongley, New York, N. Y.

513,052. Electric Searchlight. Charles E. Ongley, New York, N. Y.

513,062. Automatic Regulator for Dynamo-electric Machines. Elmer A. Sperry, Cleveland, O., and George E. Mills, Ravenswood, Ill.

The field magnets are mounted to be rotated, a responsive device being provided for throwing into and out of gear a shaft rotated by the revolving armature to rotate the field magnet in one or the other direction to change the current strength.

513,065. Automatic Electro-magnetic Switch. Herbert P. White, Philadelphia, Pa.

513,076. Trolley Wheel. George C. Bourdereaux, Peoria, Ill.

513,095. Phonograph. Thomas A. Edison, Llewellyn Park, N. J.

513,097. Phonograph. Thomas A. Edison, Llewellyn Park, N. J.

The microphone comprises balls of carbon in contact with a carbon plate to vary the resistance of the circuit. To the carbon plate is secured a mica diaphragm, which receives the sound waves and imparts movement to the carbon plate.

513,109. Electric Radiator. Walter D. Hough and Elmer Z. Burns, Niagara Falls, N. Y.

513,111. Electric Arc Lamp. William Jandus, Cleveland, O.

513,112. Gas and Electric Coupling. William J. Kelly, Boston, Mass.

513,113. Electric Light Fixture for Music Stands. William J. Kelly, Boston, Mass.

513,122. Electric Safety Device for Elevators. Robert W. Magrane, Brooklyn, N. Y.

513,126. Rheostat. Wynn Meredith, Aurora, Ill.

513,164. Telephone Index. Arthur N. Webb, Salem, Mass.

513,181. Microphone. Albin Gröper, Dusseldorf, Germany.

513,213. Electric Motor Controlling Device. Jere E. Stanton, Boston, Mass.

513,219. Electrical Bell. Charles Turnbull, Jr., North Shields, Eng.

513,220. Electric Bell. Charles Turnbull, Jr., North Shields, Eng.

513,245. Secondary Battery. Evelyn Paget and Leonard Paget, New York, N. Y.

513,250. Electric Light Cut-off. Joseph B. Stewart, Haverstraw, N. Y.

513,251. Electro-mechanical Gong. Nathan H. Suren, New York, N. Y.

513,259. Automatic Electric Stop Motion for Knitting Machines. Jules Buchel, New Orleans, La.

513,262. Electrical Time and Signaling Apparatus. James H. Gerry, Brooklyn, N. Y.

513,264. Electric Meter. John C. Henry, New York, N. Y.

513,270. Process of and Apparatus for Melting Metals by Means of Electricity. August F. W. Kreinsen, Hamburg, Germany.

513,294. Electrical Apparatus for Firing Submarine Mines. Giulio Bertolini, Venice, Italy.

513,299. Coin Operated Telephone Switch. Charles F. Brown, Yarmouth, Canada.

513,300. Electric Gas Lighter. Winsor L. Brown, San Francisco, Cal.

513,305. Telephone Transmitter. Frank R. Colvin, New York, N. Y.

To the back of the diaphragm is secured a closed receptacle containing the terminals of the transmitter circuit, which is filled, or partially filled, with a granular conducting substance and is sealed to prevent the absorption of moisture. The terminals are fixed in relation to each other, the variable resistance being secured by the variable distribution of the carbon particles between the terminals instead of by variation of pressure.

513,345. Electric Call Bell for Pneumatic Tubes. Leopold Strouse, Baltimore, Md.

513,347. Magneto electric Machine. Horace H. Taylor, Los Angeles, Cal.

513,349. Means for Neutralizing Self-induction in Alternating Circuits. Elihu Thomson and Edwin W. Rice, Jr., Swampscott, Mass.

513,350. Automatic Rheostat. Burton C. Van Emon, San Francisco, Cal.

513,352. Annunciator System. Alonzo L. Vogt, Delaware, O.

513,364. Apparatus for Registering Telephone Calls. Ludwig Kahn, Hamburg, Germany.

513,370. Method of and Apparatus for Preventing Phase Displacement in Alternating Circuits. Charles P. Steinmetz, Lynn, Mass.

The method consists in adding to the main waves of current and electromotive force accelerated current waves and retarded electromotive force waves in correspondence respectively with the potential and current strength in the circuit.

513,387. Electric Belt. Willie C. Fuller, Salina, Kan.

513,391. Electric Meter. Charles Gudgell, Independence, Mo.

513,401. Electric Motor for Street Cars. Benjamin G. Lamme, Pittsburg, Pa.

513,420. Method of Cooling the Iron of Transformers. Henry A. Rowland, Baltimore, Md.

513,421. Method of Cooling Transformers. Henry A. Rowland, Baltimore, Md.

515,422. Means for Cooling Electric Conductors. Henry A. Rowland, Baltimore, Md.

The method consists in providing hollow conductors and passing a cooling liquid through the conductors, the liquid being completely insulated from ground, or passed from the hollow conductor in the form of a spray, to prevent leakage of current to ground.

513,425. Self-induction Coil. Charles F. Scott, Pittsburg, Pa.

The coil comprises a core adapted to operate normally under a certain critical load, the core having a locally reduced cross section of only just sufficient conductance to remain unsaturated under the critical load.

513,440. Supply System for Electric Railways. Henry S. Pruyn, Hoosick Falls, N. Y.

513,457. Resistance Coil. Harry P. Davis, Pittsburg, Pa.

513,459. Dynamo-electric Machine. George F. Dieckmann, Chicago, Ill.

513,460. Commutator for Dynamo-electric Machines. Harry L. Fee, New Orleans, La.

513,466. Electrical Means for Propelling Canal Boats. Joseph Sachs, New York, N. Y.

513,469. Electric Clock System. James H. Gerry and Frederick M. Schmidt, Brooklyn, N. Y.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents expiring during the two weeks ending January 23d:

185,841. Multiple Circuit Closers for Electric Circuits. J. H. Striedinger, New York, and A. Doerflinger, Brooklyn, N. Y.

186,453. Electro-magnetic Telegraph Apparatus. Robert K. Boyle, New York, N. Y.

186,467. Electric Train Signals. L. L. Ferris, New York, N. Y.

186,503. Lightning Rod Connecting Clips. Albert Snook, Oswego, Ill.

186,518. Telegraphic Alarm and Signal Apparatus. T. A. Edison, Menlo Park, N. J.

186,545. Fire Alarm Telegraph Bell Strikers. William Donaldson, Cincinnati, O.

186,572. Electric Railroad Signals. J. D. Hughson, Prairie City, Ill.

186,642. Electric Motors. D. Ward, Binghamton, N. Y.

Western Electrician.

EVERY SATURDAY.

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Improvements in Telephone Exchange Service at St. Louis.

The substitution of storage batteries and motor-generators in telephone exchanges for the old primary batteries has become such a recognized improvement that their adoption is becoming more general. The subject is receiving much attention from telephone exchange managers. In St. Louis is a plant of this kind, and the working of the system is so satisfactory that a description of the exchanges will prove of much interest.

The central exchange of the Bell Telephone company of Missouri is located at the southeast corner of Fourth and Pine streets, St. Louis, Mo., and operates about 4,000 calls only. In addition to the usual work there are connected to the storage battery plant about sixty 16 candle power lamps for lighting the battery room, supply rooms and exchange, 100 one candle power lamps, using about one-fourth of an ampere and 12 volts each, and the relays of the signal system.

The plant at the Lindell avenue branch consists of a 2½ kilowatt motor-generator and fifty 150 ampere hour cells of the Ford-Washburn storage battery, which supplies current for all uses, including fifteen 16 candle power lamps for the lighting. The motor-generators are standard, 500 volt motors and 110 volt shunt dynamos of the C. & C. make, directly coupled. They are set with pulleys together end

In the operating room at the central office, in the center of each operator's board, are arranged terminal sockets connected with each trunk line between the central and sub-stations, each terminal ending in a socket provided with spring contacts for all necessary electrical connections for the operation of the trunk lines. Into this terminal socket fits a plug which carries the spring-jack for line connection and the signal lamp, so arranged that only the top of the lamp is exposed. The lamp is just below the surface of tha board and visible through an opening similar in size and shape and adjacent to the spring-jack. Five out of the twenty operators have on their boards terminals of the same trunks, and when one

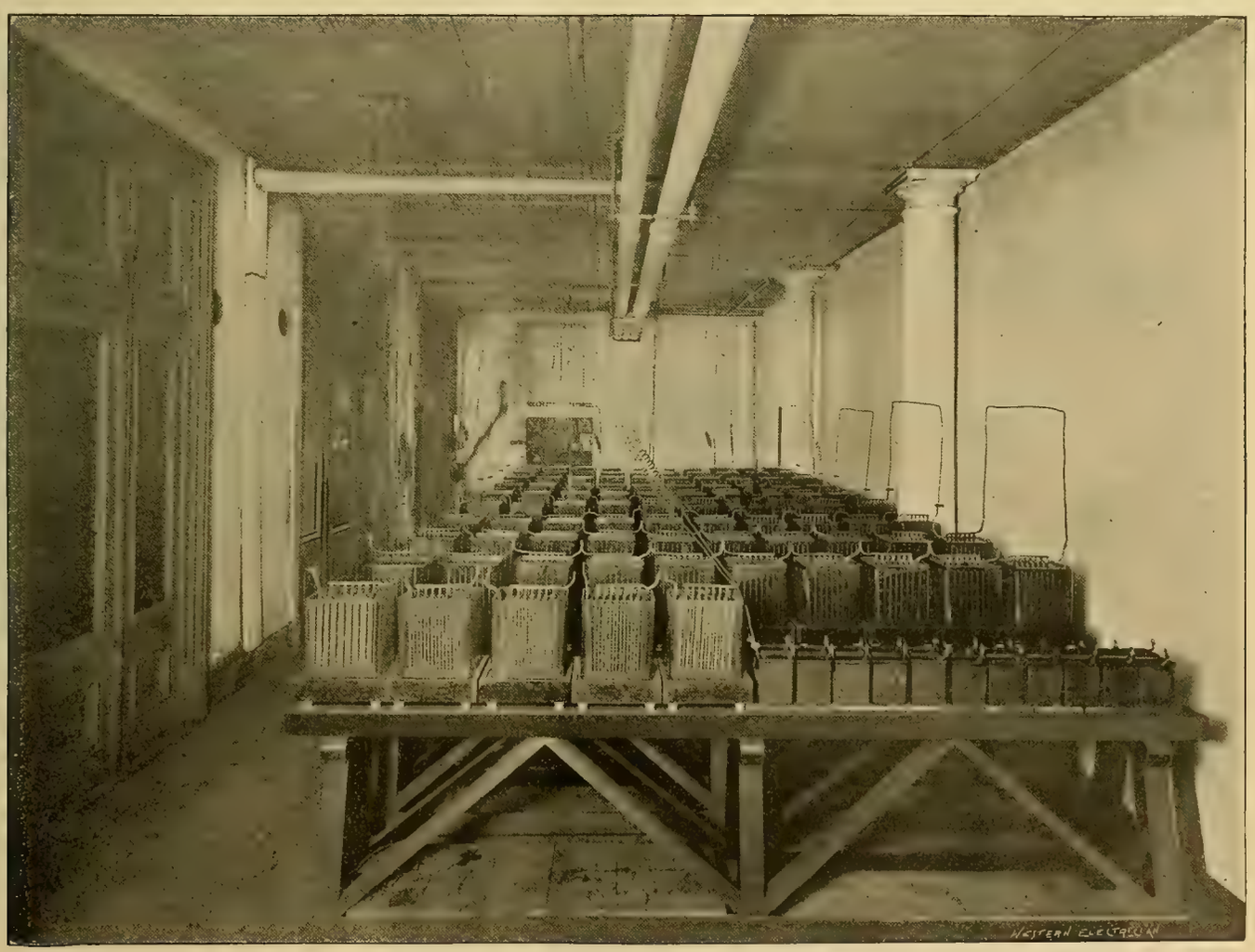


FIG. 1. IMPROVEMENTS IN TELEPHONE EXCHANGE SERVICE AT ST. LOUIS.

telephones. It is also connected to exchanges in eight neighboring towns, the most distant one being twenty-four miles. The Law system is used. Within the past year a sub-station has been opened at Thirty-fourth street and Lindell avenue, two miles from the main office, from which are operated most of the telephones in the residence section of the city, and which is connected with "Central" by trunk and transfer lines. With the opening of this branch exchange, a new system of signaling was inaugurated which required the use of more electrical energy than could be economically supplied from a primary battery, and a motor-generator plant and storage batteries were installed at each station.

The entire plant at the central office consists of a six kilowatt motor-generator and ninety 350 ampere hour cells of the Julien storage battery. A portion of the current, supplied by 42 cells accomplishes the work formerly done by 700 cells of gravity battery, which were used for telephone on, and the connection made by weaving ordinary belt lacing through between the spokes of the pulleys, thereby securing a flexible and universal coupling entirely satisfactory in its operation. The motors receive their supply from the 500 volt street mains at both stations. In the 500 volt circuit leading to the motor is an electro-magnetic cut-out which operates to open the generator circuit to the batteries in the event of a failure of the motor current, and to operate an alarm bell to notify the attendant. An automatic rheostat opens the motor circuit. By use of these devices the constant attendance of an operator is not required while charging batteries. These devices are clearly shown on the left of the switchboard in Fig. 2, where is also illustrated the motor-generator in use at the central station. These machines are well constructed and run with no noise or vibration and have proven reliable and satisfactory in their operation. Upon this page is presented a view of the entire storage battery plant in the Pine street station.

of the five puts the line in use the signal lamp of that line is lighted in each of the five operators' sections, and remains lighted while the line is in use. As these signal lamps are less than one candle power as used, the current consumed or heat developed is slight. The lamps are of special design, with special sockets so constructed that when the lamp is slipped into place in the board the circuit is complete to the line.

The operation is as follows: The operator at the central station, by inserting a plug, lights the signal lamps in "Central," connects the subscriber to the trunk and lights a signal lamp at a sub-station, thus notifying the operator at the sub-station. This operator calls for the number wanted and receives it from the subscriber calling. In connecting to the subscriber called, the sub-station signal light is extinguished automatically and remains out until the operator at "Central" disconnects, when, by withdrawing the plug, the lamp at the sub-station is auto-

matically lighted, and by the position of the trunk line plug the operator understands the signal, and by disconnecting, this signal is extinguished and the line is ready for use again. The present arrangement permits of calls being made in one direction only, and 20 trunks for outgoing calls and 30 for incoming calls are found sufficient. The feature of this system is that signals are instantly given at both ends of the line indicating what is to be done, requiring the use of the eyes only, and the signals are not easily misinterpreted. The saving in time in connecting for the subscriber is material over the usual methods of calling back and forth, and the efficiency of the service to all subscribers is much increased, because it requires no more time on the part of the operator to connect to substation than between subscribers, hence no interruption to regular rapid work occurs. By the use of the Law system, where the subscriber calls his own number, and the number he wants, there is an absence of annoying calls and little occasion for talk on the part of the operator.

The great value of storage batteries in work of this character is evident. Uniform and constant current supply at all times is absolutely essential. Ability to easily obtain a variable supply at uniform potential and different potential for different wants are important factors in the success of the transfer system. Constant operation of motors for driving generators at sub stations can hardly exist because of occasional accidents to service wires, and if that were not considered, constantly running machinery would require attention throughout the entire 24 hours and enormously reduce the average efficiency of the plant, and the necessary duplicate machinery would make the item of first cost nearly, if not quite, as great. The present plants have sufficient reserve capacity to operate their respective offices several days without being charged, should occasion demand.

Whenever a customer calls and the operator finds the connection required busy, the customer calling receives a signal of four little musical toots, which is accomplished by a buzzer being momentarily introduced into the subscriber's circuit. This idea is supposed to be a much more agreeable signal to the disappointed one calling than the nervous tap of the bell which has been the usual response. When a customer has finished a conversation and neglects to call off, the bell of his telephone taps at intervals of two seconds until the operator receives the proper signal. The periodic ringing of the bell is accomplished by connecting the subscriber to a special battery circuit which is connected through an interrupter of special design. It consists of a pendulum such as is seen in large clocks, which carries a contact of a peculiar non-arcing form to make a circuit at each complete swing of the pendulum. These momentary impulses of current pass through an electro-magnet which attracts an armature on the pendulum to keep up the motion. The circuit is then taken to each operator's table and is available at all times for attaching to the forgetful subscribers who fails to properly disconnect.

The general offices of the Bell Telephone company are located in its elegant office building at Tenth and Olive streets completed about two years ago. The upper room, where was held the meetings of the National Electric Light association last year, is intended for the exchange whenever the company is permitted to place its wires underground, a move much desired by the company and the public, but the city government has not yet consented to an ordinance acceptable to the company. George F. Durant, the efficient and popular general manager, has made many improvements in the details of the system in use which add much to the efficiency of this plant. In these improvements he has been ably assisted by W. A. Childs of New York, W. W. Dean, electrician, and J. F. Casey, chief operator.

Removal of the Chicago Office of the General Electric Company.

The offices of the General Electric company in Chicago, now located at 173 and 175 Adams street, will be removed about the 15th of this month to the new portion of the Monadnock block, on the corner of Dearborn and Van Buren streets, where a suite of rooms on the tenth floor has been secured. The office force will remain practically the same as at present. The interesting story of the beginnings, migrations and personnel of the progenitors of this company in Chicago was given in the WESTERN ELECTRICIAN of November 12, 1892.

A report states that fire consumed the Joplin, Mo., Tabernacle Congregational church and parsonage on January 22d. It is amusing to note that the report continues: "Valuable electric fire apparatus was saved by the exertion of the men."

Incandescent Lamp Litigation.

The latest decision in the incandescent lamp litigation was handed down by Judge Achesen in the United States Circuit Court at Philadelphia. The action was conducted in behalf of the Edison Electric Light company of Philadelphia, which controls the Edison patents in that territory. The defendants were three prominent consumers—the Philadelphia Trust, Safe Deposit & Insurance company, the Manufacturers' club and the Spreckels Sugar Refining company. Injunctions were granted in all three cases. The opinion filed with the decision follows:

The patent in suit No. 223,898 granted on January 27, 1880, to Thomas A. Edison, after protracted litigation and a most vigorous defense, was sustained by the Circuit Court of the United States for the Southern District of New York and by the Circuit Court of Appeals for the Second Circuit (Edison Electric Light company vs. the United States Electric Lighting company, 47 Fed. Rep., 454; 52 Fed. Rep. 300; Edison Electric Light company et al. vs. the Sawyer-Man Electric company 53 Fed. Rep., 592). The uncontradicted proofs in the several cases now before me show infringing use by the defendants respectively, and it is conceded that the plaintiffs—Edison Electric Light company and its exclusive licensee in the city of Philadelphia, the Edison Electric Light company of Philadelphia—are entitled to a preliminary injunction in each of these three suits. The court, however, is asked to exempt from the operation of the injunction certain lamps (confessedly within the second claim of the patent) which were manufactured by the Columbia Incandescent Lamp company, a corporation of the state of Missouri, for the reason that, in a suit brought against that company by the Edison Electric Light company and the Edison General Electric company in the Circuit Court of the United States for the Eastern District of Missouri after the decisions in the Second Circuit, Judge Hallett refused a motion for a preliminary injunction upon the defendants giving bond in the penal sum of twenty thousand dollars, conditioned for the payment of any sums which might be decreed in that suit in favor of the complainants therein (56 Fed. Rep., 496). The ground for this refusal was a defense then set up, which had not been made in the Second Circuit, that the incandescent electric lamp for which Edison was granted the patent was really the prior invention of one Henry Goebel. But in the earlier case of the Edison Electric Light company vs. Beacon Vacuum Pump Electrical company, 54 Fed. Rep., 678, that defense was interposed to a motion for a preliminary injunction, and was very carefully investigated by Judge Colt, who found and decided that Goebel's story of his invention in itself was so improbable and the evidence to sustain the alleged anticipation was of such doubtful character that the consideration of this defense ought to be postponed until final hearing, and that in the meantime the plaintiff was entitled to enjoy the fruits of the decree sustaining the patent. Accordingly, Judge Colt granted a preliminary injunction.

In the more recent case of the Edison Electric Light company vs. Electric Manufacturing company, 57 Fed. Rep., 616, in the Circuit Court of the United States for the Eastern District of Wisconsin, Judge Seaman expressed views similar to those of Judge Colt, and awarded a preliminary injunction to restrain infringement of this patent.

No evidence whatever in support of the Goebel defense has been submitted to me, so that I am without means of forming an independent opinion as to whether it rests upon a substantial basis. Under all the circumstances, then, to give to Judge Hallett's refusal to grant an injunction the effect here claimed for it would be to carry the principle of judicial comity to a most extravagant length. The Edison Electric Light company, of Philadelphia, vitally interested here, is not a party to the Missouri suit. But aside from that consideration, the owner of a patent undoubtedly may maintain suits for infringement against the manufacturers and users of the patented device simultaneously (Birdsell vs. Shalliot, 112 U. S., 485; Kelley vs. Ypsilanti Dress Stay Manufacturing company, 44 Fed. Rep., 19). True, pending a test suit against a manufacturer involving the validity of a patent in which a preliminary injunction against him has been decreed, courts in other jurisdictions have declined to enjoin preliminarily the users of the device. But the Edison patent has been sustained under circumstances which entitle the adjudication to high regard. It is the accepted doctrine that the decision of the Supreme Court, after exhaustive litigation upon the merits sustaining a patent, will ordinarily be regarded as conclusive on a motion for a preliminary injunction, the presumption against the existence of any valid defense against the patent prevailing at that stage of the case (Purifier Co. vs. Christian, 3 Bann. & Ad., 42, 51; Am. Bell Tel. Co. vs. Southern Tel. Co., 34 Fed. Rep., 795; American Bell Tel. Co. vs. McKeesport Tel. Co., 57 Fed. Rep., 661). I think the same effect ought here to be accorded to the decision of the United States Circuit Court of Appeals for the Second Circuit, sustaining the Edison patent.

In each of these cases a preliminary injunction in the form prescribed by the court sof the Second Circuit willbe allowed.

The Universal Electric company of Cleveland has petitioned Judge Ricks to dissolve the injunction which the General Electric company holds against it for the manufacture of the "Universal" lamp.

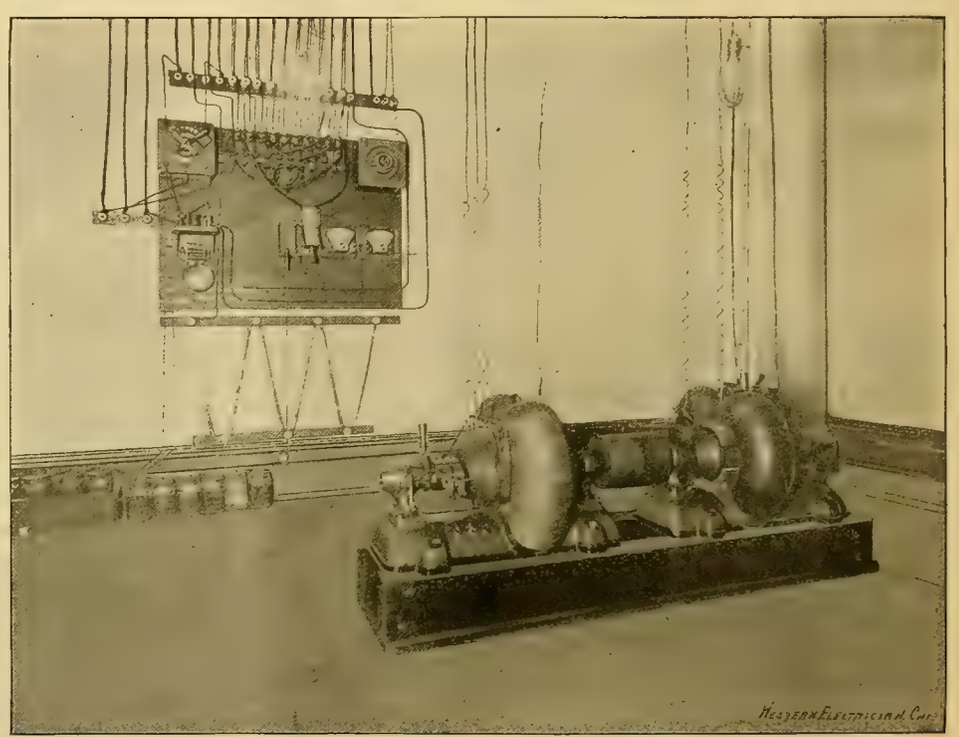


FIG. 2. IMPROVEMENT IN TELEPHONE EXCHANGE SERVICE AT ST. LOUIS.

The Good of an Ill Wind.

"There is one branch of the business at least that has not been unfavorably affected by the hard times, but has rather flourished the more," said an electrical man the other day in the course of a conversation on the improving outlook in the electrical field. "I refer to the sale of meters. At the very time when the orders for other forms of apparatus were dropping off in an alarming fashion, the demand for meters actually increased, and the trade has been brisk right through the winter, some dealers finding it difficult to keep a sufficient stock on hand. This seems curious, but I attribute it to the fact that central station men in small cities are discovering that a material saving can be effected by placing meters on the service circuits of customers, and charging for the current actually consumed. This prevents waste, as a man is careful to turn a lamp off when the light is not actually needed, and thus the station manager is enabled to supply a greater number of customers without increasing his dynamo capacity. I know of one instance in a small city where the station superintendent estimates that the use of meters has enabled him to supply 1,000 more lights than before the introduction of the instruments with the same ampere readings on the switchboard, simply by availing himself of the current which the meters showed to have been previously wasted, or, perhaps I should say, used unnecessarily. In

larger plants the difference undoubtedly amounts to the capacity of at least one big machine. Probably the hard times caused the central station men to consider this economical side of the meter question more carefully than before, with the consequent increase in the sale of instruments. At any rate the fact exists and forms a cheering relief to the 'hard times' talk of which we are now, happily, hearing less and less."

System of Electrical Distribution.

In the accompanying cut is illustrated a system of electrical distribution devised by William Stanley, Jr., and John F. Kelly of Pittsfield, Mass. The drawing shows two ordinary and well-known plans of connecting the translating devices with the secondary coils; one in which a group of translating devices is supplied by a single secondary, and the other, that shown in the lower portion of the figure, in which two secondaries are connected with the working circuit in multiple. The object of the invention is to provide a self-regulating converter or transformer system of electrical distribution, in which the primaries of the induction devices are connected in series with the main or inducing circuit and the translating devices in multiple with the secondaries by which they are supplied with current Such a system involves a primary generator capable of or adapted to yield a constant current of high tension, which by means of a converter or series of converters is delivered under a much lower but constant or uniform pressure into the secondary circuits containing the translating devices. Alternating current generators, themselves capable of or provided with special appliances for delivering a constant current, are now well known, and any generator of alternating or similar current that possesses this characteristic may be employed. Such transformers as are commonly used in the present systems of multiple arc conversion and distribution are employed, but with these devices, when thus arranged, with their primaries in series with the generator, are combined devices such as polarization cells connected up in the secondary circuits, in series with the translating devices therein, by which, when certain conditions are observed, the desired results of self-regulation of the system are secured.

In the accompanying diagram of the system G represents a constant current alternating generator, A A the circuit therefrom, and P S P S the primary and secondary coils respectively of a number of transformers, the primary coils P being included in series in the main circuit. The secondary coils constitute the sources of currents for the working or local circuits B B, in which incandescent lamps C or motors D are included or adapted to be connected in multiple arc.

The phase of the secondary current in any transformer is determined by the action of two electromotive forces; one the electromotive force induced by the primary current, and the other that of the self-induction of the secondary coil. The first electromotive force is ninety degrees later than the primary current phase, while the secondary electromotive force is at right angles to or ninety degrees later than the secondary current, and these two forces cooperate to lag the secondary current approximately ninety degrees farther than if no electromotive force of self-induction were present, or to one hundred and eighty degrees behind the primary current. While this lag exists, the objects of the invention cannot be realized, and to correct it it is necessary to interpose in each secondary circuit a device that is capable of yielding an electromotive force equal to that of the self-induction. For such devices are employed polarization cells or electrolytic condensers which consist of a series of conducting plates E F arranged in couples in jars or compartments in a trough or box H, and connected in series through an electrolyte by which they are not chemically attacked, such as carbon plates in acidulated water or iron plates in a solution of caustic potash. When a current less than that which would be necessary to produce actual electrolysis is passed through such a cell, an electromotive force of polarization is set up which for a given current is in proportion to the number of plates or couples in series and which also varies in proportion to the current. This electromotive force is available for neutralizing that of self-induction in any circuit and is an efficient and economical device for the purpose. In practice the cell should have the lowest possible resistance, which is effected by bringing the plates very close together, and it should be so constructed that no electromotive force which it is ever called on to yield should be sufficient to cause the breaking down of the electrolyte. By the employment of such a device in the secondary circuits and the neutralization thereby of the electromotive force of self induction, the secondary current s brought back to ninety degrees from the primary current.

The counter electromotive force in the primary circuit depends upon the total magnetization of the secondary cores, and this magnetization is increased by every increment of secondary current, when the electromotive force of self-induction in the secondary is neutralized, for the reason that the primary and secondary currents are then ninety degrees apart. Hence the work done by the generator upon the transformers is greater because of the increase of the counter electromotive force in the primary circuit. As lamps or other devices, therefore, are brought into the local circuits, increasing the loads on the secondaries, the generator does more work in maintaining the current constant in the primary circuit. With an increase of load on the secondaries the electromotive force at their terminals also increases by reason of the rise in the electromotive force of self-induction, but this latter is neutralized by the increase in the electromotive force of the polarization cell due to the increased current, so that the available electromotive force in the local or working circuit remains constant. It is claimed for this system that with a source of constant alternating current a constant electromotive force in one or more local or working circuits may be automatically maintained by transformers, the primaries of which are in series in the main circuit, by including in the circuits of the secondaries which supply the current to the working circuits polarization cells or condensers so adjusted or adapted as to neutralize the electromotive force of the self-induction of the secondary circuits.

A History of the Telephone.[1]

By W. Clyde Jones.

It was in 1819 that Oersted, a professor in the University of Copenhagen, while lecturing to his class, discovered that a magnetic needle, when held in the vicinity of a wire traversed by an electric current, was caused to assume a position at right angles to the axis of the wire. This experiment, though simple of performance, was a revelation to the scientific world, and confirmed the long-standing suspicion that electricity and magnetism were, in some mysterious manner, related. This was the spark that inflamed the minds of scientific men and led to the unraveling of the apparent mysteries of electro-magnetic action and the founding of the laws of electro-magnetism, to which we are in such a great measure indebted for the industrial development of the electrical arts.

Oersted had informed the world that there was a relation between electricity and magnetism, but it remained for Sturgeon, in 1825, to point out that there was not only a relation, but that electricity was even convertible into magnetism. He had encircled a bar of soft iron with a helix of wire and noted that upon the passage of an electric current through the helix the soft iron bar assumed the properties of a magnet. Here was the germ that was afterward developed into the telegraph and the telephone.

With the electro-magnet the minds of men naturally turned to the transmission of intelligence to a distance, and in the years immediately following Sturgeon's experiment we find the greatest scientific minds busily engaged with the problem. Neither the laws of the electro-magnet nor the laws governing the passage of a current along a wire, since so admirably expressed by Ohm, were at this time known, and the rapid falling away of the force of the current with increased distance led to the belief that an electro-magnetic telegraph would never be possible. Indeed, in 1829, Professor Barlow, of England, perhaps the foremost scientist of his day, after making an exhaustive study of the problem, published a demonstration, considered at the time conclusive, showing that it would be absolutely impossible to transmit intelligence to a distance by means of the electro-magnet.

But soon the dormant hope was again aroused by the publication of the researches of Joseph Henry, who had so thoroughly investigated the laws of the electro magnet that no discoveries except of minor importance have resulted from later investigation; in fact, the electro-magnet as Henry knew it in 1830 is the electro-magnet as we know it to-day.

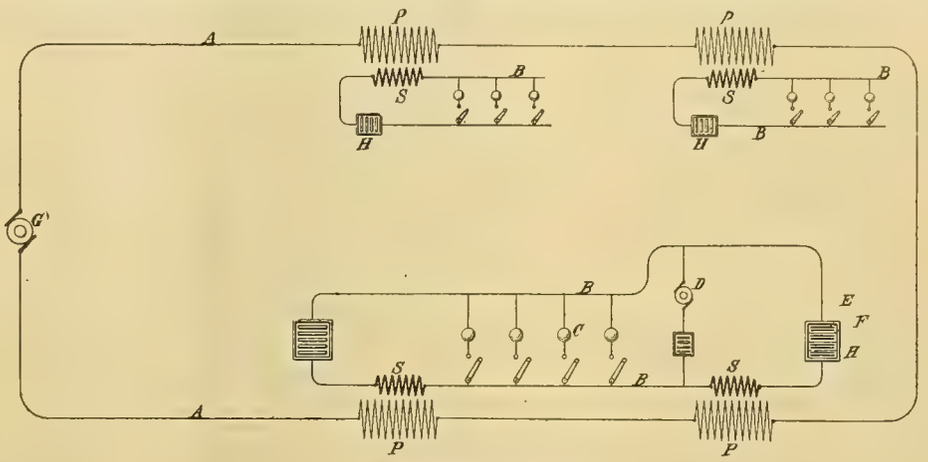
1. Read before the Chicago Electrical association January 23, 1894.

Ever since Sturgeon had converted electricity into magnetism the question ever uppermost in scientific minds was whether magnetism might not in turn be converted into electricity. In 1831 Henry and Faraday discovered that magnetism was, in fact, convertible into electricity and was effected by varying the magnetic field threading a looped conductor. By this discovery, which has rendered illustrious the names of two great men, the world acquired information concerning the laws of electro-magnetism and the mutual convertibility of the two mysterious forces that immediately removed electrical science from the domain of the purely theoretical and experimental and gave it a place in the industrial world.

"The time was now ripe for the development of the electric telegraph, and in the early 30's Samuel F. B. Morse had conceived the electric telegraph, which, toward the end of the decade, assumed practical form. With Sturgeon's electro-magnet placed at the distant end of the line, he closed an electric circuit by means of a key, thus causing the electro-magnet to attract its armature and convey to the operator at the distant end of the line the conventional signal.

Naturally, the operation of the Morse telegraph suggested the possibility of transmitting the voice itself to a distance. and, indeed, as early as 1854 we find Charles Boursel publishing to the world the possibility of speech transmission in words that have since become historic. He said: "I have asked myself if the spoken word itself could not be transmitted by electricity; in a word, if what what was spoken in Vienna may not be heard in Paris. * * * Suppose that a man speaks near a movable disk sufficiently flexible to lose none of the vibrations of the voice; that this disk alternately makes and breaks the connection with a battery; you may have at a distance another disk which will simultaneously execute the same vibrations."

Boursel erroneously supposed that the voice could be transmitted by the opening and closing of the circuit and thus outlined a path of research which science traveled for twenty years, until Bell, by his theory of electric undulations, removed it from the deeply worn rut. In 1861 Phllip Reis of Frankfort, Germany, apparently following the instructions of Boursel, constructed the first telephone,



SYSTEM OF ELECTRICAL DISTRIBUTION.

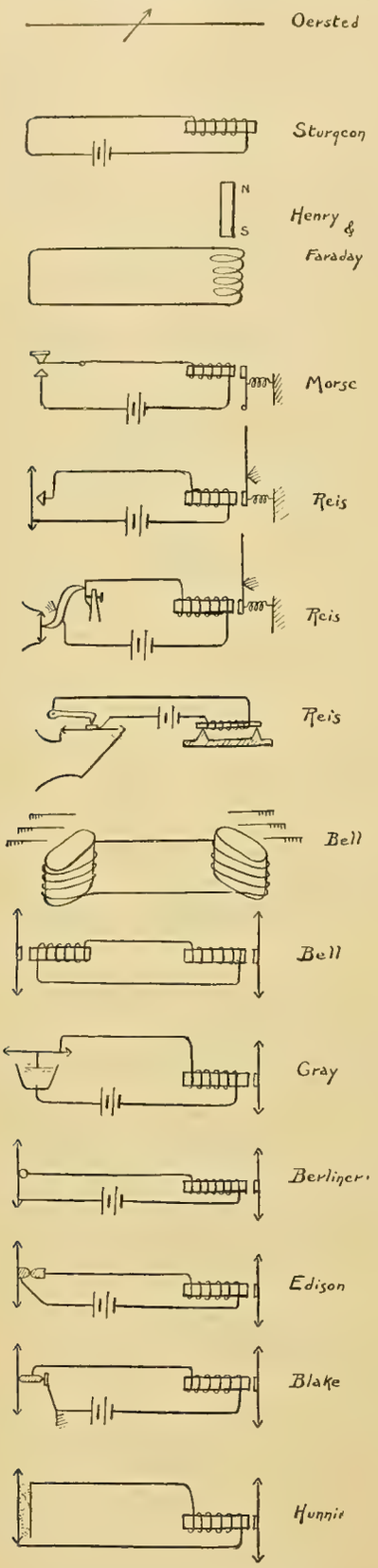
which comprised as a transmitter a diaphragm, adapted in its vibration to open and close an electric circuit. At the receiving station was placed an electro magnet, which, by the successive current impulses sent over the line by the transmitter, caused the magnet to alternately attract and release its armature, to which was secured a thin plate, which, in the vibration of the armature, was moved back and forth, thus beating the air and setting in motion the air particles that conveyed to the ear the sense of sound.

By comparing the telephone of Reis with the telegraph of Morse, it will be observed that the transmitting instruments differ only in that Morse used a key actuated by the hand for opening and closing the circuit, while Reis provided a diaphragm which, for the sake of the analogy, we may consider a key adapted to be actuated not by the hand but by the vocal organs. Again, the only essential difference between the receiving instruments was that Reis had applied to the armature of the Morse instrument a thin plate for the purpose of setting the air particles in motion.

Reis, by opening and closing the circuit, was unable to transmit the complex current undulations upon which we know the transmission of articulate speech to depend, and was only able to transmit simple musical sounds. It has been contended by some that Reis actually transmitted articulate speech by means of his apparatus and understood the requisite of speech transmission, and, in fact, that speech has actually been transmitted by the Reis apparatus by causing the contacts of the transmitter to remain continuously in contact; but that Reis himself did not understand the necessity of an undulatory current and did not transmit speech may be inferred from the fact that in his later apparatus, which was by him considered an improvement upon the former, the construction was such that it is impossible to cause the contacts to remain continuously in contact. In the former instrument a pivoted lever was provided, one end bearing against the diaphragm and the other end against the end of a spring, the circuit being from the lever to the spring. As the diaphragm is vibrated, the end of the lever is moved toward and from the spring to close and open the circuit. A screw was provided for adjusting the end of the spring toward and from the end of the lever, and by a proper adjustment the end of the lever may be caused to remain continuously in contact during the vibration of the diaphragm, an undulatory current

being thus produced for the transmission of articulate speech. In the latter instrument the diaphragm was horizontal, one contact being carried at its center, while the other comprised a lever resting loosely by its end upon the first contact. As the diaphragm vibrates the end of the lever is successively thrown away from the diaphragm to open and close the circuit. By this construction it will be observed that the contacts cannot be caused to remain continuously in contact.

It will be noticed that there is a remarkable resemblance between the receiver of Reis and the magneto telephone of Bell, the difference being that Bell secures the thin plate by its edges and provides the armature at its center, while Reis mounts the plate upon a horizontal axis and places



A HISTORY OF THE TELEPHONE.

the armature upon one end. In both the function of the plates is to beat the air; in both the function of the magnet and armature is to set the plate in motion.

We see, therefore, that Reis actually had a receiver capable of reproducing articulate sounds, had he but understood the necessities of the transmitter, and that by adjusting his transmitter so that the contacts would remain continuously in contact he would have had an articulating transmitter. Further than this, had he connected two of his receivers together, and used one as a transmitter, speech might have been transmitted. With apparatus of such possibilities, it does indeed seem remarkable that the mere oversight of not having turned a screw a fractional rotation on its axis, or of not having connected two particular binding posts by a wire, should have shifted the honor of having first transmitted articulate speech from the shoulders of Reis to those of men living half a generation later.

The apparatus of Reis, as Reis used it, was incapable of transmitting articulate speech since the only effect of each vibration of the diaphragm was to close the circuit of a battery and send a current impulse over the line. These current impulses being always of the same strength the vibrating plate of the receiver always produced tones of a given loudness, but as the rate of vibration of the transmitter varied the rate of vibration of the receiver plate correspondingly varied, the apparatus being thus capable of reproducing the pitch of the sounds. But in complex sounds, and particularly sounds comprising articulate speech, the air particles do not perform a simple to-and-fro movement in constituting the sound, but perform the cycle with more or less complexity, now advancing rapidly, now slower, perhaps receding slightly and then advancing to complete the stroke, and it is evident that any transmitter that fails to register all of these variations will fail to transmit articulate speech. Since the transmitting diaphragm of the Reis telephone merely registered the completion of the stroke and not the intermediate movements, it was, of course, incapable of transmitting articulate speech.

In the early 70's Alexander Graham Bell was working upon a harmonic telegraph, which in its essential features comprise a permanent magnet, opposite the pole of which were located a number of reeds, each adapted to vibrate at a different rate. Encircling the magnet was a coil of wire connected with the coil of a similar instrument at a distance. When one of the reeds was set in vibration it executed a definite number of vibrations, the number being peculiar to the reed, and the successive approach of its end to the end of the magnet varied the strength of the magnet, thus inducing in the coil a current which, traversing the coil at the receiving station, varied the strength of the magnet which it encircled to cause the successive attraction of a reed having the same characteristic vibration. None of the reeds at the receiving station thus vibrate except those whose correspondents at the transmitter vibrate, and, if a number of the reeds at the transmitting station are caused to vibrate, the corresponding reeds at the receiving station are set in vibration.

Now, since complex sounds may be resolved into a number of superimposed simple sounds, Bell concluded that if the reeds be mounted flexibly enough to vibrate under the influence of sound waves, and are sufficient in number, a person in speaking against the reeds would set such reeds, the vibration of which when compounded produce the sound, into vibration, thus causing the corresponding reeds at the receiver to vibrate and reproduce the sound. From this conception of the production of all the simple tones of which the complex tone is composed, Bell taking a lesson from the human ear, advanced to the conception of a diaphragm which should have not a characteristic vibration to respond to a particular sound, but which should respond to all sounds, and the development of this idea led to the production of the magnetic telephone.

Elisha Gray was at this time also working upon a harmoniac telegraph, and independently conceived the requisite of speech transmission. His receiver embodied the principle of Bell's telephone, but for a transmitter he provided means for producing changes in the resistance of an electric circuit by the variable immersion in a body of mercury of a needle carried upon the diaphragm, the needle and the mercury being included in the circuit.

It soon became evident that the electric-dynamic or resistance-varying telephone of Gray was the best for transmitting the sounds, and the improvements of Berliner, Edison and Blake soon followed. After an interference in the Patent Office, it was decided that Berliner was the first to conceive the use of two electrodes continuously in contact for varying the resistance, that Edison was the first to provide electrodes of carbon, while Blake first mounted the electrodes upon springs in a manner to prevent the breaking of the circuit and employed platinum as one electrode.

The variation of current produced by solid electrodes is limited, and the transmitter has been improved by Hunning by using granular carbon between a stationary plate and the vibrating diaphragm, a greater variation of resistance for a given movement of the diaphragm being thus secured. The Hunning transmitter, with improvements for preventing the caking of the granular material, marks the latest stage of development of the telephone transmitter.

Thus we see that the development of the telephone has been a gradual one, and has followed a logical course, and is perhaps one of the most striking examples of the fact that great inventions do not spontaneously emanate from the mind of one great man far in advance of his age, but that each but adds his mite to the amassed knowledge of society, the process continuing until some one happily supplies that last step, which, added to what has been done before, carries the undertaking within the pale of success, the last step being perhaps of no greater intrinsic merit than the others, but by virtue of its position, like the keystone that completes the arch, it becomes of the greatest relative importance. The steps, when considered in the light of retrospect, often seem small indeed, yet they were all necessary to accomplish the completed journey. Thus we see that Morse did little more than provide a key for Sturgeon's electro-magnet. Reis did but little more than substitute for the manual key of Morse one more sensitively constructed, to be operated by the vocal organs, and, instead of pounding a metal stop with the armature of the electro-magnet, pounded the air. Bell did but little more than mount the plate of Reis as a diaphragm and conceive the idea of using it as a transmitting instrument to produce the all essential undulatory current, and in fact all of the variable contact transmitters are but little more than the Reis transmitter properly adjusted. But while we, standing at a distance, are thus able to verify the words, well said, that "science moves but slowly, slowly, creeping on from point to point," we must not forget that the act is more difficult in the performance than in the after contemplation, and that all of those to whom we are indebted for the perfection of the telephone, from Oersted to Hunning, merit our praise, for each has performed an indispensable part.

The Practicability of Electric Conduit Railways.

By Albert Stetson.

Part IV.

THE GORDON AND THE LINEFF SYSTEMS.

A small conduit two or three inches square is closed at the top by an iron cover laid in concrete, and this iron top serves as the current conductor. It is divided up into short lengths, about one-third the length of the car, and these sections are successively alive as the car passes along, and are cut out of circuit when the car has passed.

POLLAK SYSTEM.

"In this system there is a middle contact rail in short insulated sections. The conductor carrying the current lies directly beneath this rail, and by means of flexible contacts momentary connections are made from it to that particular section over which the car is at that moment. These temporary connections are made by the aid of a magnet on the bottom of the car, which, in passing over, attracts iron blocks under the rails, making contact with that section."[1]

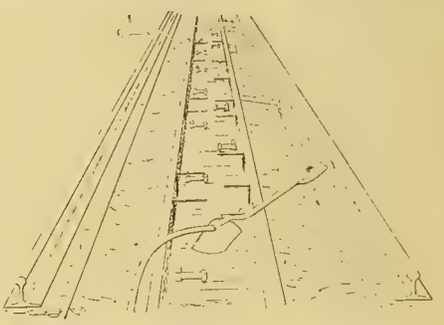


FIG. 6. THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.

Schuckert proposes a modification of this, by having iron filings, when influenced by a magnet carried on the car, bridge over the space between the main and the sectional rail. The holes containing the iron filings were made widest at the bottom, and it was claimed the sparking would do no harm, as the filings always present plenty of new surfaces of contact. This system is not in practical operation anywhere.

All will remember the announcement some time ago that Mr. Edison had invented a new system of electric traction destined to relegate the horses to the bone-yard and cable and elevated roads to the junk shop. Such announcements from time to time, coming from so eminent a source, have done immense harm to electrical enterprises, and they would utterly annihilate the reputation of any man less favorably known than Mr. Edison. Hence there were a few doubters when the pronunciamento came, and the great results promised have after all failed to materialize. The overhead system, we are told, is entirely dispensed with, cars, trucks, tracks and roadbed, such as are now in use, are retained, certain changes being made in the joints and cross ties. The power, furnished by 1,000 volt generators, is distributed to reducing apparatus placed in boiler plate manholes at intervals varying in accordance with the number of cars required to be operated. At various reducing points the current is transformed from 1,000 volts to a pressure of 20 volts, and put in direct communication with the tracks. This limit of 20 volts is fixed in order to prevent horses from being affected by the current. The economy of current is about the same as with the present system of trolley.

The chances are that that road has reached its full growth, and will never extend beyond Mr. Edison's laboratory.

Mr. Van Depoele proposed a conduit closed by flexible walls. When the shoe passed the slot was to be pushed open, and the elasticity of the sides of the slot was to close the opening when the car had passed. All right, in theory, but suppose a layer of mud rests on the top of the slot when the car comes along. It opens, lets the mud into the conduit and keeps it there. A freezing temperature would soon convince the inventor that a closed conduit was an expensive ice-making machine! Such makeshifts will not do. We must work with our streets as we find them. The operative device must be simple and of few parts, and we must keep carefully in mind that a conduit at its best is a dirty place, and that iron and steel will rust, and when rusted may refuse to work.

Mr. Mansfield, in the paper already quoted, says: "There is one more system, which practically combines all these methods, and which obviates many of the objections. The inventor has a slot between his rails and boxes, with contact device within, placed at proper intervals. Upon this car is a plow which passes along through the slot, and also a long contact plate or arrangement extending its entire length. The operation of the invention is as follows: The plow as it passes through the slot strikes a lever in connection with each box, which lifts for a distance of six or eight inches above the ground a piston carrying the contact piece proper. This is made in the

1. Hering, p. 182.

shape of a right angle hook placed in a vertically moving piston, and thoroughly insulated from it. As this is raised up the long contact plate under the car passes beneath the hook and holds it up. The current is taken into the car as the plate slides under the live hook. Naturally, as the car passes along, the hook slides off from the end of the contact bar and drops back into place. To protect this hook or contact piece proper, it is covered with an extension of the cylinder, so that, as far as the street is concerned, the surface is perfectly smooth, and one sees nothing but a small round cover in the center of each of these boxes. The contact hook is alive only when it is resting on the contact plate of the car. Certainly, in so far as getting rid of all troubles due to the street being covered with water, this is successful. The fatal weakness whereby the contact points remain permanently on the street surface is obviated here by the contact point being practically lifted six or eight inches above the surface."

Thus saith Mr. Mansfield, but there are some things to be looked at in this device. First—There are too many working parts to rust and get out of order. Second—On a dry day, dirt would get into the hole out of which the contact plate is lifted, and on a muddy day the hole would be filled up immediately, so that the plate would not go back into place. It would therefore be necessary to have a man at each contact plate, or about every six or eight feet. The plate must go back into place, in order to leave the street level. Third—The contact plate must be made very strong, in order that it may withstand the heaviest traffic of our streets. Hence the problem of lifting and dropping such a plate as would be necessary with the car going six or eight miles an hour is not simple one.

I do not wish to be rash in my judgment, but I see nothing especially promising in any of these closed conduit or surface contact devices. As Mr. Mansfield says: "Summing up the general results of the underground and surface methods, it certainly does not look as if we could expect very much from them in the immediate future."

Such was the state of the art, and such the general outlook for success, when over a year ago I became engaged in some attempts to solve the problem at Coney Island. This system was not a sudden idea but had been a gradual development. For nearly two years it was in process of development, and a number of inventors have contributed their share towards its completion and success. I

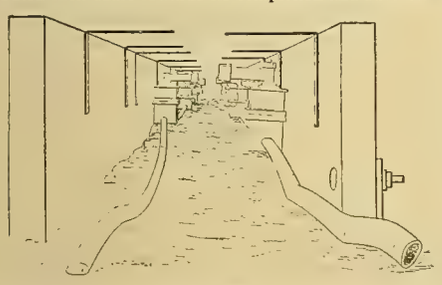


FIG. 7. THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.

believe this is a good place to tell the real history of the invention. There have been many incorrect statements in the newspapers in reference to this device. No one would object to certain persons getting credit, even if it did not belong to them. But, when, by giving this credit, a great injustice is done to those who did the real work, it becomes a matter of duty to set the affair forth in its true light. The original idea of the box used down there, and the working of it out to its completed form belongs, I may say modestly, to me.

Among those who have worked upon the details of the invention I may mention G. T. Woods, C. S. Van Nuis and John H. Dale; but whatever success it has attained has been due to the suggestions and inventions of John J. Green, who brought to the work the mind of the inventor and the skill of the trained mechanical and electrical engineer.

Such being the state of the art, the outlook being thus unpromising, knowing what had been done, having spent four months in the Patent Office, having examined the traction question on the whole continent of Europe, we set to work to construct a system that should avoid the defects inherent in other devices. To strengthen their weak points, to make an all-the-year-round system, was our object. I assert with the utmost confidence that we have succeeded. To have gone over the same old ground, in the same old way, would have been folly for any one knowing of previous attempts and failures. Perfect insulation, no live wires in the conduit, fewest possible working parts, with nothing to get out of order! These were our cardinal points. We have not attempted to make a road operative in fine weather and under ideal conditions, but have known that to ensure success we must take the streets as we find them. They will get muddy, rain will fall and snow will come, and if a slotted conduit road is to succeed it must work undisturbed by them. We have, on three occasions, filled our conduit to the top with mud and water, burying out of sight conductors, contact boxes and all the devices. The illustration, Fig. 6, shows our conduit in process of being filled. Mud of the consistency of paste was used, and the report of a disinterested electrician, not known to me personally, brought there by the editor of one of our leading electrical journals, shows that the system was in no manner affected. With the shoe of the car in the mud, with boxes entirely submerged, the ordinary measuring instruments failed to show anything but the best insulation, and no disturbance of traffic would arise with 50 cars and with a conduit filled with mud and water. No such condition would ever present itself in railway work, but a space of several hundred feet might get full of mud, snow or water, and the successful system must not be disturbed by such trifles. We made our mud test, not once, but three times. When the last test was made our boxes had been under the mud four days. Four days' submergence is a terribly hard test, but if the line then works perfectly there is absolutely nothing to apprehend from an occasional filling up during a shower.

DESCRIPTION.

A conduit is used, similar to that of cable roads, but nothing like so large or expensive. With our improved shoe a conduit two or three inches wide and seven inches deep will answer perfectly. In the slot of the conduit, attached to the car, runs a shoe extending nearly the length of the car.

Fig. 8 shows the shoe detached from the car; the upwardly projecting pieces are the guides for making the shoe follow the conduit and conform to the curves

The shoe is so supported that should the car leave the track it detaches itself immediately and remains on the

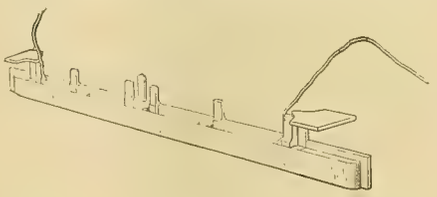


FIG. 8. THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.

top of the conduit. It cannot get caught, as the cable grip sometimes does, and drag the car along through crowded streets at a dangerous speed. As seen in the illustration, the shoe is somewhat like a cigar in shape, so as not to give any sharp blow to the contact arms. The sides of the shoe are formed of conducting material, insulated from each other, and perfectly flexible, so as to follow any curves. The shoe can be attached to and detached from a car in five or ten seconds.

In the conduit are placed two insulated cables, a metallic return being used. This I regard as necessary to ensure perfectly safe working. These cables run into and through contact boxes placed at intervals of ten feet on each side, they being arranged diagonally opposite, so that the distance between the boxes is about five feet. The construction of the boxes and the functions of their various parts will be readily understood from the illustrations, Figs. 9 and 10. One shows the box closed and the cable running into the box, the other the box opened and the method of securing contact with the cable.

The main is carried into the box and, as can be seen, the lead and insulation removed for about two inches. Onto this bared cable there is placed a brass clamp with two upwardly projecting tongues.

The contact-making portion of the device is a vertical rod, having at its upper end an arm projecting into the conduit, and at its lower end a brush adapted to be brought into contact with the tongues attached to the cable. This rod and its bearings must, of course, be properly insulated from the contact box. When no car is passing, the brush is out of all electrical connection with the current conductor, but when the shoe on the car reaches the arm projecting into the conduit, it swings it to one side, bringing the brush on the rod into contact with the tongues fastened to the conductor, and the current passes to the motor on the car. As soon as the shoe on the car has passed the box, a torsion spring forces the rod back into its normal position, and that box is dead. The box is filled as far as it can be without interfering with the movement of the brush with solid paraffine, and above that with "transil oil." This makes excellent insulation. Of course the spindle, which at times becomes "alive," and its bearings are thoroughly insulated from all parts of the box and cable. Nothing can be better than an insulated cable, covered throughout its entire length with a

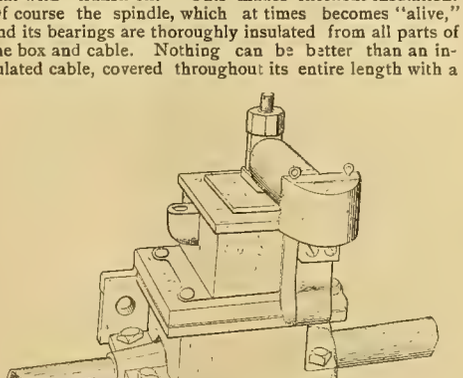


FIG. 9. THE PRACTICABILITY OE ELECTRIC CONDUIT RAILWAYS.

highly resisting material, and at the points where current is supplied to the car an insulation practically infinite.

No accident to persons or animals appears possible with this system. To avoid sparking within the box, the ends of the shoe are made of insulating material, thereby establishing mechanical contact within the box before the metallic portion comes into contact with the arm, and also holding the inside contact after the current ceases to flow to the motor. This is an important feature, for without such an arrangement the brushes would soon burn out, the oil become carbonized and the boxes useless.

Thus far I have described the box that we used at the Island, but it has long since been consigned to the usual receptacle for the rejected productions of progressive inventors. It did its work and did it well; it pointed the way to better things, and we have several forms of box, entirely obviating the defects in the first. The number of working parts has been reduced, and we now have the device brought down to its lowest terms. I regret that it is not possible for me to show these improvements, but patents have not been obtained on some, and on others not yet applied for.

As a guide for future investigators, I will enumerate the best features and the defects of the old box, as I understand them. First—Its insulation was excellent; that is, the theory of its insulation was. But oil insulation is in many cases a fraud, a deception and a snare. The best oil insulation is not so good as that of air containing 80 per cent. of moisture. Oil and water, perhaps, won't mix, but oil will attract moisture, and the two will make an emulsion that will cause the investigator much sorrow and mental anguish. Ordinary paraffin oil, even the highest grades obtainable, contains a great deal of water, which, in a device like this, will cause disastrous short-circuiting. Transil oil seems the best for the purpose. At Coney Island, before we adopted transil oil, our boxes would go wrong, in spite of all we could do, and we only discovered the trouble by putting some of our oil in a bottle to settle over night, and in the morning found an abundance of water in the bottom. Solid paraffin is the only substance that we found capable of withstanding the action of paraffin oil, and it must be the refined variety, such as is sold in hard, white cakes. Its use even was discarded, for when the water would work down the spindle through our imperfect stuffing box, the solid layer formed a bed for the moisture to rest upon, and being close to our brush, it short-circuited the box. It is better to let the moisture settle to the bottom of the box, out of harm's way. I don't think oil should be used on account of its insulating properties, but for keeping the working parts from rusting. Second—Our old box was made in several parts (a mistake, remedied in our new one-piece box), and the joints required planing, an expensive operation. Paraffin oil is difficult stuff to hold, going through almost everything. In the joints we used oil paper, screwed them together as tightly as possible, but the oil softened the paper and the boxes leaked. This we remedied by painting the joints with "insullac," which

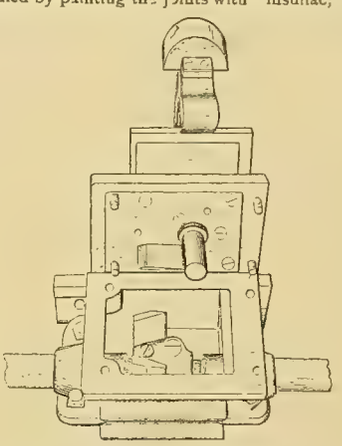


FIG. 10. THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.

withstood the oil excellently. Third—Our stuffing box was a crude device, and did not, in many cases, keep out the water; but this is a simple mechanical affair remedied in our new boxes. Fourth—A torsion spring is not so good as a straight one, nor so reliable in its action. Fifth—We had a short brush in our box, when a long one should be used. Flexibility and sure contact are thereby secured. Sixth—It was a mistake to have the two upwardly projecting tongues; one contact is the thing, and the brush always resting against it when the shoe touches the arm. Otherwise there will be a break on reversing and consequent "frilling" of the brushes with carbonization of the oil. Seventh—To make an oil-tight joint between the cable and the box was almost an impossibility. We taped the cable where it entered the box, but when it was tightened up there was often contact between the lead covering and the box. Eighth—The box is too large. Ninth—Great care must be used in selecting and laying the cable. A slight defect gives leakage; this decomposes the alkaline earths; chlorine and caustic soda are perhaps produced, and the cable eaten away. Every joint must be carefully made and carefully sealed. Some one may say that it is impossible, but I answer that it is the duty of the supervising engineer to see that it is properly done. If any one thinks this cannot be done, he is not my ideal engineer, and certainly does not want to meddle with electric conduit railways. These are the defects, but we have cared them all in our new system. The excellent principle of the old box has remained untouched by long experiment, the laterally yielding arm being the only form likely to answer the purpose.

A Short-circuit Causes a Series of Explosions.

Quite a little excitement was caused in the neighborhood of the Chicago postoffice last week by the blowing up of five man-hole covers in the immediate vicinity. The iron covers were thrown many feet in the air, and it is remarkable that no one was injured. The manholes are used as entrances for the Chicago Edison company's arc light conduits. The explosions were probably caused by a short-circuit in the conduit which ignited the gases there confined.

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WE have tried advertising in several electrical papers, and after discontinuing our advertisement in your journal [*Electrical World*] we advertised for a considerable period in the WESTERN ELECTRICIAN, which we found a valuable paper for reaching the West, our card in that paper bringing us many communications, a number of which resulted in sales of our alternating apparatus, including a plant for the University of Wisconsin.—*Extract from a letter of F. A. La Roche, president of the La Roche Electric Works, Philadelphia, to W. J. Johnston, publisher of the Electrical World.*

CINCINNATI is considering the question of burying electric wires, and the agitation has been taken up in other parts of the state. A general underground conduit bill has been prepared and is now before the Legislature. It provides that in cities of the first class the right may be granted to construct, maintain and operate subways for placing electrical conductors beneath the surface of the streets. It is also provided that the city may purchase the subway after 25 years, the purchase price not to include any sum paid by the company to the city for the franchise, but to depend entirely upon the value of the subways at the time the city takes possession. The rental for the use of the conduits shall be determined by the board every ten years. It is hardly possible that the bill will pass in its present form, as the companies that would build the conduits would require more protection for their investment than that provided in the conditions of the present bill.

MAYOR GILROY of New York is not enthusiastic over the proposition of Banker Wilson; in fact it may be safely said that he is opposed to it, and the best indication of this is the fact that he has proposed that the question be submitted to a vote of the people. He says: "I do not believe in any amendment to the constitution, and will not support one which authorizes this city to loan its credit to any private corporation. Opening the door to such projects would not be conducive to the best interests of the city. I am not in favor of the city entering into any project into which private capital will not enter, unless the question is first submitted to the people. I do not favor giving a loan to a private corporation, because I have before me the fate of the government loan to the Union Pacific railroad. If private capital would be willing to invest in this road, I would be in favor of exempting the investment, or even the structure itself, from taxation until such time as it would be on a paying basis." There is no doubt that Mayor Gilroy's position is a good one, whether it be considered from a financial or political view point. It is easy to see that the project could be defeated at the polls. The people of New York are proud of the financial standing of the municipality and they would do nothing that might tend to imperil it. Unless the politicians have the distribution and control of the funds they would undoubtedly defeat the measure. It is almost too much to expect that New York will get rapid transit through Mr. Wilson's plan.

THE recent decision of the United States Court of Appeals at St. Louis in the case of the United States government against the Western Union Telegraph company and the Union Pacific Railroad company is a very important victory for the defendants and is of especial value to the telegraph company. The case involved an alleged infringement of the "Pacific Railroad Acts" by the old Union Pacific Railroad Company, inasmuch as, being bound to build and operate by its own servants and agents a line of telegraph for commercial and governmental purposes between Omaha and Ogden, it has leased lines, poles, wires, instruments, offices, etc., to the Atlantic & Pacific Telegraph company, and on July 1, 1881, surrendered its franchise and alienated its powers under its charter to the Western Union Telegraph company. The complaint alleged that the United States had a lien upon the railway and telegraph lines of the company, and that by surrendering its franchise to the telegraph company it had avoided and refused to perform its duties, and, further, had granted a monopoly of the telegraph business along its line to the Western Union company. The United States Circuit Court at Omaha had decided the case in favor of the government, and it was an appeal from this decision that brought the case before the United States Court of Appeals last week. Judges Caldwell, Thayer and Sanborn, before whom the appeal was argued, handed down a decision reversing the finding of the circuit court judge.

LAMP makers generally throughout the country experienced a sense of relief upon reading the decision and opinion of Judge Ricks in the Buckeye case last week. The General Electric company, however, announces that it will continue the policy it has followed, and press the suit to a final hearing. The situation is somewhat complicated, too, by the recent decision of Judge Acheson in the case of three consumers at Philadelphia, which is presented in this issue. In this action the local Edison company, which is the exclusive licensee, brought action against these institutions to restrain them from using lamps other than those made under the Edison patents. The defendants asked that the court exempt from the operation of the injunction certain lamps which were manufactured by the Columbia Incandescent Lamp company, for the reason that, in a suit brought against that company in the Circuit Court of the United States for the Eastern District of Missouri, after the decisions in the Second Circuit, Judge Hallett refused a motion for a preliminary injunction upon the defendants giving bond in the sum of $20,000. The ground for this refusal was a defense then set up, which had not been made in the Second Circuit, that the incandescent electric lamp for which Edison was granted the patent was really the prior invention of Henry Goebel. But in the earlier case of the Beacon lamp this defense had been interposed to a motion for a preliminary injunction, and Judge Colt decided that the consideration of this defense ought to be postponed until final hearing, and that in the meantime the plaintiff was entitled to a preliminary injunction. In the more recent case of the Electric Manufacturing company, in the Circuit Court of the United States for the Eastern District of Wisconsin, Judge Seaman expressed views similar to those of Judge Colt, and granted a preliminary injunction to restrain infringement of this patent. No evidence in support of the Goebel defense was submitted to Judge Acheson, and he decided that "under all the circumstances, to give to Judge Hallett's refusal to grant an injunction the effect here claimed for it, would be to carry the principle of judicial comity to a most extravagant length."

Of course, it must be remembered that Judge Ricks' decision had not been handed down when the Philadelphia cases were submitted, and the defense there introduced was not presented for Judge Acheson's consideration.

IF it shall be found that a trolley conduit system is impracticable or too expensive for the proposed street railway improvement in Indiana avenue, Chicago, as is probable, why not erect an overhead trolley line? The residents on the street have good reason to be dissatisfied with the existing horse car service and are casting about for some measure of relief, hoping that it will be possible to induce the Chicago City Railway company to operate the cars from buried trolley wires. It is altogether likely, however, that a determined effort to obtain rapid transit on the street by means of the overhead electric system can be undertaken with a fair prospect of success, whereas the building of a trolley conduit, in the present state of the art, is a remote possibility, to say the least. The most recent experiment with an underground electric system on a commercial basis is that now making in Washington, and those who have followed it carefully are compelled to admit reluctantly that it has not proven an entire success. It will be difficult to induce the Chicago City Railway company to build what must be conceded to be but little better than an experimental line in Indiana avenue at a cost of $80,000 or $100,000. Will it not be wiser, then, for the residents on the street to bend their energies to securing the comparatively cheap overhead system, which, after trial in nearly every city in the country, is conceded to give excellent service?

Indiana avenue is well adapted for the erection of a model overhead trolley line. It is a long, straight thoroughfare, almost entirely devoted to residences. There are very few tall buildings, so that the cry of interference with the work of the firemen would have no weight. Indeed, with the center-pole construction heretofore proposed and illustrated in the WESTERN ELECTRICIAN of April 23, 1892, and with buried feeders, this objection could not be raised in any event. It may also be remarked that the street is already supplied with double tracks, so that no greater proportion of the roadway would be occupied. The opponents of the improvement will contend, of course, that the center line of poles, with the cross-arms and suspended wires, will mar the sightliness of a fine residence street. But is this a valid objection? We think not, and we commend the pictures before alluded to, showing the avenue with and without the overhead trolley, to those who entertain a different opinion. If a construction similar to the one there illustrated be employed, every fair-minded man must admit that the esthetic drawback would be very slight indeed when compared with the advantages of the system. The actual obstruction to traffic on the street would be also unimportant.

As the people living on Indiana avenue are, as a rule, cultivated and well informed, we take it that there is no danger of their being misled by the hysterical "deadly trolley" cry of a portion of the Chicago press. In itself, the trolley system is as harmless as the horse cars. Of course in crossing the street between corners pedestrians must calculate on the increased speed of the cars, but rapid transit is just what the residents of the avenue are clamoring for.

If the people on Indiana avenue are really desirous of an improvement in their street railway facilities, and will give the subject careful and unprejudiced consideration, we are confident that they will insist on the best type of overhead trolley construction. Such a line as we have suggested would bring no regret to the residents on the street and would undoubtedly be the forerunner of others on outlying Chicago streets, where the conditions are advantageous.

The Telephone Situation.

Reports from all parts of the country indicate that widespread interest has been aroused by the announcement of the expiration of the Bell receiver patent on January 30th. The general public is thoroughly disgusted with the greediness of the Bell monopoly, and is eagerly hoping that the expiration of the receiver patent will open the way for a free use of the telephone in all its applications. While it is probable that not all of the bright anticipations of non-technical telephone users will be realized, owing to the lavish expenditure of money made by the parent and licensee companies within the last two or three years for self-protection, and also to the number of subsidiary patents for improvements owned by the Bell company, there seems no doubt that a fine business in private line instruments will spring up within the next six months, and, indeed, this demand may be said to have begun. All of the important electrical supply companies are figuring on telephone business, and several have non-infringing instruments ready for immediate delivery. No one need delude himself, however, with the belief that the American Bell Telephone company is going out of business for many years to come. The recent application for legislative permission to increase its capital stock $30,000,000 shows, if indication were needed, that it intends to fight. Another fact of great importance is the announcement of the Metropolitan Telephone & Telegraph company of New York that it will sell hand telephones outright for $2.50. Of course if the Metropoliton company can sell telephones, the inference is that the Chicago Telephone company and other licensees can do so also. This indicates that the Bell people are themselves making a bid for the private line business, and, with their position and experience, they can hardly fail to secure a considerable portion of the new business. Still, the people at large are so much opposed to the idea of doing more business with the Bell company than they are compelled to that the monopoly will have to offer great inducements to overcome this repugnance. In relation to the Berliner transmitter patent, it may be said that the prospect of a speedy decision in the suit brought by the government for annulment is not encouraging. Everybody realizes that the methods by which this patent was kept in interference and finally issued were scandalous; but the movements of the government in legal matters are proverbially slow at best, while in the present case the existing administration, for some reason, appears to take no particular interest in the prosecution. If some private concern which was injured by the delay should push the case vigorously, a decision could undoubtedly be reached much sooner; but the trouble is that a decision annulling the patent would be of equal value to all the companies opposed to the Bell interest, so that the complainant would be virtually fighting the battle of its business competitors. In central exchange business in large cities but little has as yet been done in the way of actual competition with the Bell licensees, but many projects are on foot and there may be more tangible developments later.

NOTES AND PROJECTS.

The president of the Western Telephone Construction company of Chicago asserts that the Bell company has voluntarily settled the infringement suit which it brought against the former some months ago. He adds that he does not know why the Bell company did this unless it was because it did not want to answer questions which would show up facts in its organization that it desired to conceal. The Western Telephone Construction company recently asked for a franchise. The ordinance is in a committee of the Chicago city council. President Keelyn says that the company will open an exchange in Chicago, but he can not say when. The company, he says, has a factory in Chicago equipped with $100,000 worth of machinery and is manufacturing telephones to sell. "Where is the factory located?" he was asked; and in reply the president said: "For certain reasons I cannot give that." The company announces, however, that it is installing its first exchange at Albert Lea, Minn., where about 100 instruments are being put in on the automatic system.

Attorney Edward Kibler of Newark, O., has prepared a bill for the Ohio Legislature pertaining to the establishment, ownership and control of telephone exchanges by municipalities. Senator Iden will probably introduce the measure.

A dispatch from Milwaukee states that a number of the retail druggists who are fighting the introduction of the automatic telephone, with its concomitant 10 cent fee, have issued a circular to telephone subscribers asking for co-operation in the war against the telephone monopoly. The druggists say that a mass meeting of the telephone subscribers will be called in a few days. The druggists insist that a person who pays rental for a telephone should be allowed to use the instruments, no matter where they are located.

The Harrison International Telephone company is said to enjoy the unique distinction of being the only telephone company that has won in a legal contest with the Bell people. It claims to have had for several years exchanges competing directly with the Bell telephone. In Fort Smith, Ark., are two telephone exchanges, each having 600 instruments. The central offices are on opposite corners of two streets, and one is the Bell and the other the Harrison.

Last year there were 552,720 telephones in use in this country. They were all owned by the parent Bell company, whose gross earnings for rent and royalty and dividends from subordinate companies amounted to $5,100,880. The net earnings were $3,411,674.

In speaking of the relations of the Western Union Telegraph company and the American Bell Telephone company, the *Chicago Tribune* says: "It is difficult to see how any new concern could attack the telephone monopoly with a tithe of the effectiveness that the Western Union could if it chose, and on the other hand no concern could make it as lively for the Western Union on short order as the American Telephone company. It has hankered for a long time to go into the telegraph business, so that it might utilize its plant to the utmost, and make its wires pay a double profit, telephoning by day and telegraphing by night. It will be able to do so in a short time if it chooses, and it is well for it to be in readiness to fight back if the Western Union attacks it."

It is stated that the old Pan Electric Telephone company has come to life again in St. Louis. It proposes to sell telephones outright.

A local exchange company has been organized in McKeesport, Pa., to use the Shaver system. It is proposed to extend the lines to Pittsburg and Allegheny.

The old Drawbaugh company is endeavoring to secure a franchise for an exchange in Philadelphia.

The Northwestern Telephone & Electric company is the name of a corporation recently organized in Milwaukee with the intention of establishing telephone plants in places throughout the Northwest, particularly in the smaller towns. Negotiations are now being made for plants at several places in Wisconsin.

The Colorado Telephone company of Denver—a Bell company—appears to be well entrenched, as it has its conduits under the asphalt paving of the business district. An opposition company has a franchise, but it does not intend to do anything at present.

The *New York Tribune* has the following: "From a trustworthy source it was learned that the Metropolitan Telephone & Telegraph company was putting itself in a position to kill all competition. It was learned that the Western Electric company, which does much of the work for the American Bell Telephone company, had received orders to manufacture so many instruments that an increase had been ordered in the working force of the company, and that all the smaller telephone companies throughout the country were to be equipped with the latest and best instruments at a price so low that it would be impossible for new companies to compete with them."

DR. D'UNGER ON THE SITUATION.

To the Editor of the WESTERN ELECTRICIAN:

With your permission I will give, correctly, the information so many people are seeking, and I will give it, too, in words so plain that there can be no mistake about it, first remarking that many of the uninformed are blinded by roguish people stamping articles as patented which are not. The application for a patent is not a patent. I think it is illegal for any applicant for a patent to send out his invention as patented on the strength of an application; but in the telephone business this villainous scheme to deceive has been much resorted to. Now for the facts as to the controlling telephone patents:

1. The first patent of A. Graham Bell was not for a telephone at all, but for an "improvement in telegraphy." It was issued March 7, 1876, and expired March 7, 1893. This was the basic patent, so called because the United States Supreme Court, in the case of Drawbaugh and Bell (a suit for priority of invention), decided that Bell had found the way and that nobody else had any right to send sound by electricity, and that sound was speech. The braying of an ass is sound, but it is not speech. The telegraph had used sound for forty years! Nevertheless this absurd decision was made and people had to abide by it. The court was equally divided on the question, Judge Waite, the chief justice, having the deciding vote. He cast it with the Bell half of the court and then he—Waite—died the next day. A minority opinion was published by the Drawbaugh half of the court.

2. The next patent was a "combination" patent, secured also by Mr. Bell, on January 30, 1877. This patent expired on Tuesday, January 30, 1894. It was the first telephone patent. In Bell's first patent neither the word "speech" nor the sending of words by electricity was referred to or suggested.

3. In 1877 both Edison and Berliner applied for electric telephone patents, in which carbon was used. The Western Union Telegraph company first secured the rights of Edison, the American Bell Telephone company securing the rights of Berliner; so it was concluded between these two companies that, as Edison and Berliner had somewhat the same ideas, they would just unite as brothers and allow the matter to lie in the Patent Office, the Western Union Telegraph company thus joining hands with the Bell people, an agreement being entered into which gave to the Western Union twenty per cent. of all the money that could be squeezed out of the people in the telephone business. In consequence of this deal, then, in the United States Patent Office, the claim of Berliner rested until November 17, 1891—fourteen years—and the claim of Edison until later on, May 3, 1892; that is, on November 17, 1891, Berliner was given a patent, and on May 3, 1892, Edison was given a patent.

4. There were other patents, among them Blake's (issued November 29, 1881) and the Hunning, an English patent (issued August 30, 1881). But let the public distinctly understand that all the telephone patents of Blake, all the telephone patents of Edison, as well as that of Hunning, are now dead, null and void. Their legal demise was brought about by expiration in a foreign country, where they were either applied for or granted before being applied for or granted in the United States. The United States Supreme Court decided that question March 27, 1893. The existence of a patent here ends when the patent for the same thing expires in a foreign country, provided application for the patent was first made abroad. It is paradoxical, but nevertheless true, that the Edison patent of May 3, 1892, was actually dead before the United States patent office issued the certificate for its life. But right here is a scrap of information very important to the public: Although any person now has the right to manufacture either a Blake, a Hunning or an Edison telephone, such telephone must be made in strict accordance with the original specifications. When these instruments are thus made they are worthless for commercial purposes, because of their constantly getting out of order. The fact that patents were granted for them is no evidence of their worth. A few words were transmitted by them and this was sufficient to secure patents; but, as for commercial work, as telephony is now understood, it is simply out of the question. It is true the Bell company has managed to get along with them, after a fashion, but it has only succeeded in doing so by combining the brains, as it were, of Edison, Blake, Berliner and Bell; a hearing instrument from Bell, a spring and some platinum from Blake and a carbon button from Edison and Berliner. Even with this crude combination there is, has been and always will be, a large amount of annoyance, as all telephone users know. This defect—an almost fatal one—is due entirely to the fact that such instruments clog up. They have to be constantly cleaned if only reasonably fair work is to be gotten out of them. Both the carbon button and platinum point require a good deal of rubbing up, hence all the repairers of such telephones carry with them pieces of emery paper and likewise a quantity of tissue paper.

5. There are hundreds of magneto telephone patents, such as that of Bell's, which expired on the 30th ult.; but it is not necessary to refer to these, it being well known to every electrician that the only serviceable and reliable telephone must of necessity be an electric telephone. In a magneto telephone (I do not give this as information to electricians) the electromotive force is the mouth; and, although we have many loud-mouthed people on this earth, particularly spies, ferrets perjurers and legal parasites of big monopolies, very few have lung force enough to get up induced currents sufficiently powerful to carry voice vibrations a mile, much less a hundred or a thousand miles.

6. The Hunning, the Bell, the Blake and the Edison patents dead—what next? Then comes the D'Unger all carbon microphone transmitter, an all carbon multiple contact telephone transmitter, patented October 2, 1888, consisting of four carbon pencils swinging from a metal road and resting at a particular angle on a carbon bar, the bar itself fixed in a yoke at one end of a lever, the opposite end of said lever being fastened by a hinge to the centre of the diaphragm or voice-plate and the lever so arranged that the strength of the voice-wave on the bar is nearly four times more powerful than the voice itself. This arrangement not only makes the instrument more powerful than any other now known, but it makes it a self-cleaning machine, a property no other telephone has. Being the inventor and patentee, it is not for me to speak of its merits. I will merely say here that, during the last four years, more than six thousand telephone users have tested it, including hundreds of the leading experts of this country, England and France.

From the foregoing it will readily be perceived that the recent expiration of the Bell and other patents is not, after all, of much real service to the public. True, the people can have magneto 'phones; but, as already said, magneto phones do not fill the bill.

The stories flooding the newspapers—east, west, north and south—to the effect that the American Bell Telephone company has hundreds of patents stowed away, etc., and that nobody else has a switchboard or magneto-signal bell, are mere bosh, sent out to deceive and confuse the people. That monopoly is not now the owner of a single telephone transmitter patent that is worth a dollar. They do own the Berliner patent, of November 17, 1891, but the United States government, which began a suit on February 9th, 1893, to vacate this same Berliner patent, on the ground of fraud, has accumulated a wagon-load of testimony, which will prove that what has been given to Berliner should have been given to Edison, and that the reason why it was not given to the latter was because, had it been so given, it would have been null, as Edison had put in an application for the same thing in England, whereas Berliner had not put in a foreign application. It was impossible to prolong the monopoly with the Edison claim. It is probable, though, that the most important of all the testimony

secured is that there remains nothing whatever of Berliner's original application but his signature and the signatures of his witnesses. There are piles of expert testimony and many affidavits proving irregularities in the patent office, collusion and non-compliance with the patent office laws, on the whole showing that specifications for a valuable thing have been substituted for specifications of a worthless thing, it being conclusively shown that what Berliner had asked a patent on was of no value whatever.

But what need of all this? The very point in question, in a parallel case, has already been decided in the United States Circuit Court, Judge Nixon presiding. The case is that of the Bate Refrigerator company versus Gillett. The decision of the court was that the date of the application for a patent has nothing to do with the matter of its issuance that patent dates from its issue. The Berliner patent is dated November 17, 1891. Hence, I claim that, so far as its carbon-microphone is concerned, it is an infringements on the D'Unger telephone patent, which was granted more than three years before. This is not my opinion alone; it is the opinion of several of the ablest patent attorneys in the United States.

I can assure the public, who are soon to have the benefit of the D'Unger telephone in exchanges (hundreds of them are already in use in private lines) that any attempt to infringe upon this patent will be attended to with such vigor and determination as will convince the most timid that there exists at least one telephone company in this land that will protect its legal rights and that it cannot be scared or bluffed out of existence. As the D'Unger patent was granted before the expiration of any foreign patent on a microphone of any kind whatever, it is the only valid patent on an all-carbon contact telephone transmitter in this country.

It only remains for me to thank you for your manly efforts to disabuse the public mind of the idea that, because the Bell company has a big switchboard and a gravity switch connected with a signal bell nobody can give the public telephony. There is no patent on the fundamental principle of a switchboard—no patent on the fundamental principle of a magneto bell. There may be a thousand patent switchboards and a thousand patent magneto bells, for aught the public or I know or need care. The Chicago Twine-Wire company (I am not a member of that company) does not need a switchboard, or signal such as the Bell people are using; indeed, it would be foolish to adopt it. It will use something else that will do the work much better and quicker. They will give good service at about half what the people are now paying for poor service. The D'Unger telephone has and will be on exhibition every day except Sunday, from 2 to 4 P. M., at room No. 733, Palmer House. It is daily sending voice vibrations through a resistance of 36,000 ohms, and will send them through 100,000 ohms. Respectfully,

R. D'UNGER

Electric Railway Agitation in Chicago.

The residents on Indiana avenue, Chicago, are becoming dissatisfied with the horse car service on that street, and are discussing the prospect of electric traction. This street is one of the important residence thoroughfares of the South Side, but the horse car line is operated as a feeder to the Wabash avenue cable road, and the rate of travel upon it is exasperatingly slow. As pointed out in a paper read by Frank L. Perry before the Chicago Electric club nearly two years ago, and published in the WESTERN ELECTRICIAN of April 23, 1892, Indiana avenue offers exceptional advantages for an overhead trolley line, with center-pole construction, the esthetic objection being reduced to a minimum, and hardly worthy of consideration in view of the unquestioned advantages of such a system. Illustrations were presented at that time showing Indiana avenue with and without overhead construction, the appearance of the street showing no "disfigurement" in the latter case. The residents on the street have not decided, however, on the system they wish to adopt, and it is not definitely known what arrangement can be made with the Chicago City Railway company. At a meeting recently held in the Lakota Hotel A. W. Wright of the American Siemens & Halske company explained the trolley conduit system in use in Budapest, and offered to put a similar line in Indiana avenue at a cost of $37,500 per mile. A committee of five was appointed to consider the matter and to confer with the railroad company.

Electric Light Convention.

An innovation for the Washington convention beginning on the 27th of this month is an invitation extended to electric railway companies to send representatives. The discussion on the use of storage batteries in central stations and on the electrolytic effects of earth-return currents will be of especial interest to railway men. A rate of a fare and a third has been secured from all sections of the country except that portion west of the Mississippi and north of Burlington, Peoria and Chicago, the cities named being included in the rate. It is hoped that a like concession will be obtained for the territory farther west. The local committees on transportation are as follows: A. C. Shaw, Boston; C. F. Hesser, Cincinnati; H. A. Cleverly, Philadelphia; E. H. Heinrichs, Pittsburg; M. J. Sullivan, Chicago; Jas. I. Ayer, St. Louis; E. R. Weeks, Kansas City; W. W. Borst, Denver, Col.

Air Core Transformers.

BY FREDERICK BEDELL AND ALBERT C. CREHORE.

In a paper on "The Behavior of an Air Core Transformer When the Frequency is Below a Certain Critical Value," read before the Physical society, October 27, 1893, E. C. Rimington has called attention to the case in which the primary current of a transformer falls off when the secondary is closed. This phenomenon was noted by us last spring and attention called to it on June 17, 1893, in Article V., on the "Theory of the Transformer," where a curve is drawn showing the value of the primary current for different loads. We have not yet seen the full text of Mr. Rimington's paper, but from various references to it would infer that much of the same ground has been covered by him as was given by us in a paper before the Electrical Congress in Chicago last August, entitled "General Discussion of the Current Flow in Two Mutually Related Circuits Containing Capacity," printed in full in the *Physical Review* for September and October, 1893. In a more recent communication Mr. Rimington calls attention to the fact that Mr. Kennelly, in an article entitled "The Impedance of Mutually Inductive Circuits," covered some of the same ground as given by him in his paper before the Physical society. In a geometrical treatment of the same subject, "Theory of the Transformer," VIII., we showed the identity between analytical and graphic methods of solution, including that of Mr. Kennelly, and showed that the whole is derivable from the results given in the paper above referred to presented by us before the Electrical Congress.

This decrease in the primary current of the transformer as the load increases, where the constants of the transformer have certain particular values, is certainly an interesting one, although the amount of increase would always be small. Although the transformer has been the subject of a great deal of discussion, and its theory has been approached from all sides, and the instrument experimented upon by many different methods, it is still a fruitful source of study to the theorist and experimenter and there is still room for the discovery of many facts interesting and unique.

COMMUNICATIONS.

Improvement Suggested for Ohm Sifters.

To the Editor of the WESTERN ELECTRICIAN:

The writer has read with interest your note in the last number of the WESTERN ELECTRICIAN in regard to the "ohm sifter" accident at Hazel Park, Minn., and also your proposed remedy. It is with extreme reluctance that I venture a suggestion in regard to this method of yours, but I feel it my duty to state that your proposed method was discarded by many some two years ago. Since the advent of the "Westinghouse vacuum," methods have changed as to the best treatment of "ohm sifter" troubles of dynamos. For instance, suppose the ohms and volts had become congealed in the volt wire before the dynamo tender had noticed the trouble? Even the instant reversal of the dynamo would not have been sufficient to have forced the ohms out under this condition. By boring a small hole in each field magnet of the dynamo and keeping a few quarts of "Westinghouse vacuum" on hand all trouble such as described may be speedily righted. In case of trouble all that it is necessary to do is to pour a small quantity of "Westinghouse vacuum" in the holes in the field magnets and then quickly cork up the holes. The combined action of the vacuum on the field magnet convolutions and the violent hysteresis effect produced thereby will promptly draw back all of the ohms that were in the volt wire. The ohms may be collected and saved by catching them as they drop out of the positive lug of the dynamo in a metal scoop with insulated handles.

Ohms will get in the volt wire of either direct or alternating current plants, although seldom to such an extent as to injure the automatic ampere controllers lately placed on the market, and the method suggested by the writer can be used with safety and advantage in nearly all electric light and power plants.

The ohms collected may be preserved by placing them in a barrel and covering them with water, and when a sufficient number are on hand they can be sold to storage battery companies, who buy them in bulk in large quantities.

Chicago, January 27, 1894. C. K. M.

Testimonial to G. B. Pennock.

To the Editor of the WESTERN ELECTRICIAN:

My attention has been called to a circular issued by George B. Pennock, in which my name is unwarrantably used, and which, to say the least, is misleading.

To a casual observer, this circular would appear to be a report of an exhaustive test of the Pennock system of multiplying power by a "volt distributor," and assumes that I would be responsible for the statements and figures contained therein.

A more careful perusal of the subject, however, would reveal to the experienced engineer the real object of the author (to mislead), so there is little need to warn those posted in such matters; but, for the benefit of laymen, and would-be investors in electrical enterprises, allow me to say, through the columns of your paper, that I have never made a detailed report of the Pennock system of distribution for any one.

At the solicitation of a client, I called at Mr. Pennock's laboratory, to investigate the workings of the machine. After listening to Mr. Pennock's explanation of, and claims for, his crude apparatus, and taking several readings of the current output of his battery while doing various kinds of work, I was unable to report a multiplication, or saving of power to any extent whatever, by the use of the "volt distributor," much less to verify Mr. Pennock's large claims to economy.

Before seeing Mr. Pennock's apparatus, I suggested to my client that the electricians of the country condemned it as a fraud, though I visited the exhibit in Boston with a fixed determination to give due credit to any point of merit I might find.

My search for merit was fruitless, but a careful survey of the exhibit, and of the methods employed by Mr. Pennock and his satellites, confirmed the report I had heard of this system in other localities.

A hungrier set of parasites is seldom seen, seeking as their prey any one with money. The bunco steerer's vocation seems mild when compared with this.

In the circular referred to, Mr. Pennock has arbitrarily assumed conditions and figures to suit his own convenience, while the facts in the case do not warrant a single conclusion in this truly wonderful document.

New York, February 2, 1894. C. S. VAN NUIS.

Electrical Engineering of 1893 from an English Point of View.

In a carefully written review of the work in electrical engineering for the year 1893 the *Engineer* of London makes some interesting comments on the electrical showing at the World's Fair. With the exception of one or two inaccurate statements—such as the assertion that practically all the exhibitors in the electricity building were allied with either the General Electric or Westinghouse companies—this portion of the article is well considered and fairly written, constrasting favorably in this respect with the splenetic strictures of some of the distinctively electrical English journals. It is as follows:

Passing now to the exhibition, we have, of course, dealt with the electrical exhibits at considerable length in our columns. Perhaps the most striking feature in the United States and in the exhibition grounds was the great development of electric traction. While in Great Britain there are as yet very few street cars worked by electricity, the number in the States is enormous, and is rapidly increasing.

The Intramural railway, in the grounds of Jackson Park, was somewhat similar to the elevated railway at Liverpool, and although this type has not as yet displaced the use of steam upon the elevated tracks of New York and Chicago, it is doubtless destined to be used to a large extent in future. The electrical industry in the United States seems to be almost entirely in the hands of two very powerful corporations, the General Electric company and the Westinghouse company; and although the names of many other electrical firms appeared in the electricity building, these are merely the titles of firms which have become absorbed by one or other of these powerful corporations. One great point observable in the American practice is the standardizing of the various machines and accessories; this doubtless facilitates the work of supply, and the principle does not appear to be sufficiently closely followed in this country. The electricity building at the Chicago exhibition contained a large number of interesting exhibits, but there were very few departures from ordinary practice in the machines exhibited. The great experience obtained with street car motors has led to several different types of motors, each of which appears to have its special although different advantages. Upon the lagoons in Jackson Park about fifty-two electric launches might be seen in motion, and the charging arrangements for these were very convenient. The electric fountains worked very successfully, and the electric lighting of some of the large buildings was both artistic and satisfactory, especially that of the dome of the administration building, which was perfectly lighted, no lamps being visible from below, as all were hidden in recesses round the dome itself. Two electric welding plants were exhibited in the electricity building, one by the Thomson-Houston company and the other by the Burton Welding company. Both of these work upon similar lines, and appear to be of use for long, thin objects more especially; they of course differ entirely from the Benardos arc process, which, in the hands of Lloyd & Lloyd of Birmingham has attained some success in Great Britain, while the Thomson-Houston process does not appear to have found so much favor as was expected, except for the welding of wire and thin bars. The electric motor is being largely applied to hoists, and several good arrangements were described in our columns. The machinery building, however, contained perhaps the finest exhibits in the whole exposition, consisting of the great generating plant which supplied electricity for all the various purposes except the Intramural railway. The large dynamos built by the Westinghouse company were splendid examples of American practice, and they were driven in some cases by belting and in others direct. The switchboard was very well finished, and was much more substantial than might be expected from the United States practice in ordinary small central stations. It appeared to us that Great Britain was very poorly represented indeed, and this was especially noticeable, as the exhibit of Germany was exceedingly fine, and adjoined the British section. Up to a late date it was quite uncertain what space would be taken up by British exhibitors, and a lamentable lack of energy was shown. The application of electricity to elec-

tric cranes was well illustrated by fine overhead travelers in this building, and in many cases motors were employed to drive detached exhibits. Arc lighting was in almost all cases carried out by direct high-tension currents, as they are considered in the States far preferable to alternating currents for this purpose. The World's Fair was no exception to the general rule that great sums are spent by the exhibitors in advertising devices, and much ingenuity was displayed in producing varied artistic effects by means of lamps. The purely telephonic interests were well represented by the Bell Telephone company, who had installed their stand to represent a central telephone exchange. They also had a special direct telephone line from Chicago to New York, a distance of close on one thousand miles, and a special person was detailed to attend to the wire, so that the public might be able to use the line. There appears, then, to be no reason why the chief cities in the United States should not be connected by trunk lines.

So much had been heard and read concerning the successful alternate current motors in the United States that visitors to the exhibition were naturally curious to examine specimens of these machines. The Stanley motor appeared to be, perhaps, the most novel type, but all labored under the disadvantage of being difficult to start with full load when using a current of such a high frequency as is usually employed in the States; and we may remark that this frequency is about 130, while in Great Britain it varies from 60 to 100, and on the Continent goes as low as 42. One of the novelties shown at Jackson Park was an instrument known as Professor Elisha Gray's telautograph, but the unsatisfactory point was that no visitors were allowed to see the internal construction of the machine. Writing performed at one instrument on a special desk was reproduced upon a similar desk at the other instrument; but so far as we know it is as yet impracticable to write above two or three words per minute. Possibly, however, the future may see an improved machine which will be commercially useful. The Edison phonograph was in great request at the exhibition, and the public were enabled to hear all sorts of songs repeated. Instruments of this class have recently been imported into this country in large numbers, and at many street corners they form an attraction to the public. Another method of telegraphing drawings was exhibited in London during the past year, at the Royal Institution, by Francis Galton. This, however, was a method of telegraphing by means of code signals, and reproducing the drawing in a series of dots at the distant end. With respect to coal-cutting by electricity, very little advance has been made in the past year. The disastrous coal strike, which lasted such a long time, made the colliery owners unwilling to spend more money in expensive machinery, but in the future there is no doubt that the result will be to make the masters more anxious to attain a position of independence of the collier, and employ ordinary laborers to attend to coal-cutting machines. There were at Chicago several good examples of special tools, which differ considerably from those which have found most favor in Great Britain.

The same journal gives considerable space to a comparison of the existing methods of street railway traction as developed and advanced in 1893, which will be read with interest in the United States as the testimony of a competent and disinterested British observer. A long extract is given:

Among the subjects which are just now attracting much attention, none possess, for the moment at all events, more interest than the question of traction on tramways. We have dealt pretty fully with the electrical aspect of the subject below, but it is by no means to be supposed that electricity will have it all its own way. From first to last it is a question of money, and that system which has the smallest working expenses will in the long run, other things being equal, prevail. There are five principal systems, leaving out horse traction. These are steam, compressed air, the cable, gas and electricity. Steam has achieved but a qualified success; compressed air has so far attained to no commercial importance. The race lies just now between electricity and the cable, which latter, almost unknown a few years ago outside the United States, has now attained a large measure of popularity. In United States it is said that there will very soon be 800 miles of track, representing a capital of £25,000,000, at work. In Melbourne almost the whole length of the tramways, representing about 130 miles of single track, is worked by cable. In Sydney the system is being adopted. The most recent development of the system is the line constructed between Kennington and Streatham-hill by Mr. Colam, which has been fully described in our columns.

Only two other methods of traction remain to be mentioned, namely, the oil and the gas engine. Experiments are being carried out in this direction. It has yet to be seen what success will be obtained. With us horses continue to be more employed than any other means of haulage. We do not like overhead electric conductors in our large towns. We do not like steam engines in our streets. Air-propelled cars have not been a success, and underground electric conduits have failed. There is, however, one exception to this, which is the Budapest conduit line. Although numerous circumstances conspire to make this an economic success, there is at least one detail in the conduit which cannot be followed elsewhere, namely, the width of the slot, which is big enough to allow the tires of narrow carriage wheels to fall in. We do not, however, see why anything more than half an inch is necessary for this slot, for a collector could be made of sheet copper, which need not be more than a sixteenth of an inch in thickness, might be of considerable length in the direction of the slot, so as to give plenty of strength, and might be well insulated and then surrounded by a wearing armor. As to leakage, it cannot be seriously urged that the loss on this account from moisture, etc., in an underground conduit need be a serious source of loss; and, indeed, not necessarily very much more than that on the South London or the Liverpool overhead line, where, especially in the latter case, very large steel conductors, open to all atmospheric conditions, are used successfully. In very few places has the difference between the cost of haulage by electric means been sufficiently in favor of electricity, as compared with horses, to invite successful tramway companies to discard the latter or to enable the poorer companies to obtain new capital for working on a new system The sources of loss by underground electric conductors have been supposed considerable. This is not necessarily the case with the overhead conductor, but in crowded towns and narrow streets, and wherever crossings are numerous or not of a simple order, the overhead system involves highly objectionable features. It must, however, be admitted that in a good many places the overhead conductors might be so arranged and supported as to offer no grounds for serious objection, and we may expect in the near future such modifications in the propelling machinery, as well as the overhead gear, as will make the system practically and commercially satisfactory where horse haulage is now too expensive. Hitherto secondary batteries have not been successful for tramway purposes. It has not been found possible to make them strong enough to stand the work, or if strong enough they have either been too heavy, or of insufficient discharge capacity. With cars worked by current from overhead it is merely a question of cost in generating station machinery and of motors on the cars to provide the power required. But it is not so with secondary batteries. We are of opinion, however, that alterations can be made which will make it possible to work tramways by these means and economically. Secondary batteries will probably become possible when the rapid discharge now required at starting or ascending a hill is not necessary. If, for instance, it becomes possible to work with motors of half the power now found necessary, the same weight of battery as that now used—with but little if any success—might be retained and only half the discharge rate called for. This would enable the tramway engineers to use batteries with electrodes of greater strength, and although the efficiency, measured by unit of weight of battery carried, would be similar, the actual efficiency would probably be greater. At present it is common to use at least 30 horse power on an electrical tramcar, the 30 horse power only being required to take up the current necessary for starting. In very few cases is more than perhaps a dozen horse power necessary for ascending gradients, and ordinarily not more than from three to four horse power is required on level roads. Now it is possible to work with motors through the medium of power gearing in such a way as to call for not more than half the power now demanded for starting a car, and this means not only economy in the size, cost and weight of the motor and car, but a constant saving at the generating station on whatever system the cars are worked, and, as we have before said, it is not at all likely that electric tramway working can be a commercial success so long as 30 and 40 horse power is found necessary on a two horse car as it is at present.

The Liverpool overhead railway, constructed under Sir Douglas Fox and Mr. Greathead, was opened on the 4th of February last, and has been a practical success from the first; and there seems to be no doubt that it will be a dividend-earning line throughout the winter as well as the summer when the West End extension is completed, which will bring the length up from five miles to over six miles. This is the first overhead line in this country, and the first anywhere worked electrically. The working is very satisfactory, and ought to lead to the construction of more electrical lines. The success is such that the line is worked for less than 4d. per train mile, and the company owning the line is so satisfied that this is the case that it has taken over the whole installation and working of the line from the Electric Construction Corporation, by whom the line was equipped and has until recently been worked on an undertaking to work it for two years from the date of opening. The load diagram, however, shows that more power is used, and, therefore, more fuel consumed at the generating station than would be necessary if smaller motors were used on the cars, with arrangements to enable the motor to run at its full speed when starting the cars at low speed. The motors in this case are placed directly on the axles they drive, but this does not prevent doing that which appears to be necessary to economy.

Electricity as an Aid to Business.

"The desk of a business man nowadays is quite a mass of machinery," said the manager for a commercial firm to a Washington *Star* reporter. "Observe this one of mine for example.

"To begin with, here is a phonograph, into which I dictate all my letters. Afterward a young woman, who acts as my amanuensis, takes the cylinders and copies them off. For communication otherwise than by writing I have at my hand a small stand that supports a telephone. It is ornamental and movable. I put it out of the way or set it in front of me, according to my convenience.

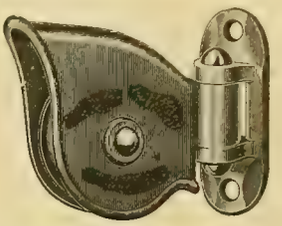
"With this little instrument I can talk from my desk with all the world. It is a long-distance telephone, and with it I can call up Boston as easily as Baltimore. Besides, I have at my other elbow a similar contrivance for communicating with the various rooms under my superintendence in this building. At a moment's notice I can make connection with any one of them by sticking the plug into the proper place in this circuit board.

"My desk is a center to which ever so many wires run for a score of different purposes. Some of them furnish me with electric lights. Others give power to my electric fan. Overhead you will notice a clock, which at noon every day is corrected by electricity from the naval observatory. My office is a nest of machines and wires, the latter reaching out to the uttermost ends of the earth, for, by means of this telegraph sounder at my left hand, I can transmit intelligence to Europe, to India, to New Zealand or to Hong Kong. It is not without reason that this is called the age of mechanical civilization."

Decision Against the Detroit Citizens' Railway Company.

An interesting decision was handed down by Judge Taft of the United States Circuit Court on January 21st in the case of the city of Detroit against the Detroit Citizens' Railway company. The action was a suit in equity to compel the company to cease running its cars and to remove its tracks from the public streets. The street railway company's franchise expired by constitutional limitation in May, 1893, and it was held that the city could not give nor the company receive a franchise extending beyond that date. The property and franchises are now, however, and have for four years past been, held by companies succeeding the original grantee, whose charter period extends beyond the term of the franchise granted in the streets, and it was held that the city, in dealing with these companies under the ordinance of extension, was estopped from invoking the law against them.

Judge Taft's final decision is that there is no estoppel,



NEW POLE PULLEY.

and that the companies are out of the possession of the streets. The amount of property affected by the litigation is $4,500,000, of which $1,500,000 is in stock interests and the balance is first and second mortgage bonds. The decree is that the company has no rights in the streets of the city except upon two streets, and that it is to be enjoined from running cars after three months upon any of the prescribed lines. It is hoped that in this time opportunity will be had to adjust the controversy, so that a new grant may be given the company upon reasonable terms, or that the plant may be sold at an appraised value to some new company. The railway company's attorneys announced that they would appeal within twenty days.

New Pole Pulley.

One of the latest improved devices to be placed upon the market by George Cutter of Chicago is a new swivel pole pulley, a cut of which is presented herewith. This form of pulley is built upon the same general lines as the old type of Cutter's swivel pole pulley, which has been in use for several years, and which is said to be giving good satisfaction; but, instead of requiring a special screw for fastening it to the pole, it has a wall-plate which can be secured with a couple of ordinary lag screws. This wall-plate is made of malleable iron, and curved so as to fit the pole, making the support both strong and quite rigid. That such a pulley will always swing into line with the hoisting rope, so as to avoid any chafing of the rope, is evident, and this point, added to its other good features, will no doubt command a good market for it.

The Scenic Line to Washington.

The attention of members of the electrical fraternity in the West and Northwest, who contemplate attending the Convention in Washington, February 27th, 28th, and March 1st, is directed to the fact that the Big Four and Chesapeake and Ohio Railways are making special arangements to carry delegates over these popular lines which are pronounced the most picturesque route from Chicago or St. Louis to the Capital. All trains are vestibuled, steam heated and electric lighted, and equipped with dining cars and elegant sleeping cars. The C. & O., from Cincinnati passes through many of the battle fields of the Revolution, and of the "late unpleasantness," and the mountain scenery is unsurpassed anywhere east of the Rockies. It is proposed to have the delegation meet in Cincinnati, and go from there in a body. A rate of one and one-third fare for the round trip has been granted. For time cards or descriptive matter, rates, etc., address E. O. McCormick, Passenger Traffic Manager, Big 4, Cincinnati, D. B. Martin, Gen'l Passenger and Ticket Agent, Cincinnati, W. F. Snyder, G. W. A., St. Louis, or J. C. Tucker, G. W. A., 234 Clark street, Chicago.

John Scott Medal Awarded to Nelson W. Perry.

Nelson W. Perry has been awarded the John Scott medal by the Franklin Institute for his "system of series electric traction." Following is an abstract of the report of the Institute on the award:

Without entering into the decision of the relative merits

of the series and multiple arc systems of railway electrical traction, which may well be assumed to be affected by the circumstances of their use in urban and suburban, inter-urban traffic, and of the need for extension of lines beyond the originally planned limits, it may be said that the very ingenious system presented by Mr. Perry seems to be well worked out in detail and appears to overcome the difficulties arising in previously suggested series systems. * * * As far as can be determined of a thing which exists, so far as the knowledge of the committee extends, only on paper, and subject to the risks which invariably attend reduction to practice, in the opinion of the committee a railway may be practically operated by the series system under Mr. Perry's plan and with the safety due to a perfectly served and constantly signalled block system, about which there can be no mistake, for the current which drives the car not only sets the signal but refuses to work when two cars come on the same block. The Institute therefore recommends the award of the John Scott Legacy, premium and medal to Nelson W. Perry for his system of series electric traction.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 5.—The last week has been one of excitement and activity in rapid transit circles and it looks very much as though the underground schemes which have been pushed to the front recently will culminate eventually to the advantage of the people of New York who require better and more rapid transportation facilities than are now at their disposal. The rapid transit commission has carefully considered the proposals made by Banker Wilson in regard to the underground road, supported by the syndicate which he represents, and that body endorsed them and submitted its approval to Mayor Gilroy. The mayor, however, has objections to the financial side of the plan. He said: "I do not believe in any amendment to the constitution, and will not support one, which authorizes this city to loan its credit to any private corporation. Opening the door to such projects would not be conducive to the best interests of the city. I am not in favor of the city entering into any project into which private capital will not enter, unless the question is first submitted to the people. I do not favor giving a loan to a private corporation, because I have before me the fate of the government loan to the Union Pacific railroad. If private capital would be willing to invest in this road, I would be in favor of exempting the investment, or even the structure itself, from taxation until such times as it would be on a paying basis." Mr. Wilson demurred at the proposal to submit his proposition to a vote of the people, but he finally agreed that in the end this might be of considerable advantage.

However, the commission, at a meeting held last week, received a proposition from a representative of another syndicate which, although it is veiled in mystery to a certain extent, is looked upon with much approval. This syndicate is headed by John H. Davis & Co. and is said to consist of 13 New York banking firms, a number of English capitalists and a couple of railroad magnates. It is fostering an underground plan and is prepared, it is stated, to furnish the entire amount of capital necessary to construct and operate the road. It is expected that at the meeting of the commission to be held to-morrow this new bidder for rapid transit privileges will be the chief subject of discussion.

Although underground talk monopolizes attention to a great extent the Bushe elevated road plan has not been entirely dropped. It is conceded, however that this plan is practically out of consideration. Vigorous protests from interested property owners are received almost continually, and it is probable, that even if the underground plan should eventually be found impracticable, the public would reject the route as laid out by Mr. Bushe.

Assemblman Butts introduced a bill into the New York Assembly January 31st, prepared by the trades union rapid transit conference in New York city, which provides that in the general election to be held next November the people of New York shall vote upon the question of constructing and owning a new rapid transit railway. The present commission is legislated out of office and the appointment of a new rapid transit commission of three by the mayor is provided for. The new commission may adopt any portion or all of the plans considered by the present commission, and it is provided that all property consents obtained by the present commission shall be lodged with the new commission. If the people vote against municipal ownership, then the franchise shall be put up at public sale and sold to the highest bidder. If the people vote in favor of city construction at the following November election next year, they shall vote on the question of municipal operation. If the people vote against municipal operation, then the right to operate the road may be leased to a company for a term not exceeding fifty years. The promoters of the bill are in favor of the adoption of an underground rapid transit system.

A new submarine cable, of large proportions was stretched under the East River last week from the foot of Thirty-eighth street to Hunter's Point, Long Island city near the foot of Eighth street. The cable was manufactured by the Safety Insulated Wire & Cable company for the Metropolitan Telephone & Telegraph company. It will be used to connect the up-town exchanges of this city with those of Greenpoint, Astoria, and Flushing. It takes the place of six other cables, which had become worn out and were taken up recently. Its outside diameter is 2¾ inches. It is nearly 5,000 feet long, and weighs twenty-one and a half tons. It contains twenty conductors, each of which consists of three strands of fine wire. In making the new cable each conductor was covered by an insulating compound and then wrapped in a covering of light tarred tape. Four of these conductors were made to form the central core of the cable. A jute serving was then applied, making the core cylindrical. This core was also protected by a covering of tarred tape. The other sixteen conductors were twisted in pairs, each pair having been treated with the jute serving. The eight pairs of conductors were then laid around the central core. The cable thus formed was protected with a covering of heavy tarred tape, and then served with two layers of tarred jute. An armoring of galvanized iron wires gives additional protection to the conductors. This armoring is also protected by coverings which prevent it from corroding. As soon as the conductors have been carefully tested, the cable will be ready for use.

W. F. O.

Northwestern Notations.

MINNEAPOLIS, February 5.—George F. Stitch of Chicago, president of the Wisconsin Automatic Telephone company, has arranged for organizing a stock company to put in a system connecting Superior and Duluth, Minn., using the Strowger patents.

Some important changes have been made in the official personnel of the St. Paul & White Bear Electric railway. W. S. Morton has resigned the position of president and is succeeded by H. M. Eyllesby who will also be general manager. H. C. Lewis succeeds Lane K. Stone as vice-president. The board of directors consists of Messrs. Eyllesby, Lewis, Joseph Lockey and Lane K. Stone. Mr. Morton has sold some of his stock, but retains an interest. The new deal is calculated to improve the company financially.

Charles Schwartzhopf of Lester Prairie, Minn., has manufactured a dynamo for an electric light plant for the roller mills at Glencoe, Minn.

A telephone line between Lester Prairie and Winstead, Minn., has been put in operation.

The Beacon Electric Light company of St. Paul has removed to 354 St. Peter street, where a reproduction of considerable machinery and display work that attracted attention at the World's Fair is now to be seen. This company is the northwestern branch of the Western Electric company of Chicago. It has made a proposition to the city of St. Paul to light the sections of the city now illuminated by gas for $75,000 per year, instead of the $105,000 now paid for gas, and at the end of five years to give the city the plant and system entire for $1. The plant to be put in, it is estimated, will cost about $100,000. Mayor Wright, in submitting the proposition to the council, urged the appointment of a special committee to consider the offer. He went over the matter in a general way, without indorsing the Beacon company's proposition. The company proposes to put in 400 arc lights of 2,000 candle-power each.

The city hall and court house commissioners of St. Paul are engaged in a dispute with the St. Paul Gas Light company over the contract for lighting the city and county building. There is talk of putting in an independent plant.

The street railway company at Minneapolis does not make very rapid headway toward getting its cars vestibuled as required by the new law. As the weather has not been very severe lately no great commotion has been made over the matter. The company is waiting for a snow storm to test the efficiency of the new snow plow which it owns. The tests which have been made shows that it possesses unique and efficient features. The electrical equipment is enteresting. It weighs 33 tons and ten motors are required to run it.

The fact that more rapid headway has not been made in complying with the "vestibule" law has led some patrons of the company to begin actions to compel compliance with the law. The question of the constitutionality of the law has been raised and will probably go to the Supreme Court. The weather has been so mild that the vestibules have not been missed.

The recent investigation of the quality of electric light being furnished the city of Mankato, Minn., has resulted in the shutting off of lights and the advertising for proposals for lighting the city for ten years. If satisfactory bids are not received, a municipal plant is proposed. The call for proposals is open until March 1st. All arc lights must be of 2,000 candle power, and incandescents of 32 candle power.

Dr. W. W. Bradley of Forman, N. D., is projecting a telephone line from Forman to Coggswell, and east to Milnor, via Ransom, about 30 miles.

An ordinance has been passed giving the St. Paul Gas company the right to put up poles and wires on all streets in the city except Summit avenue west of Selby avenue.

Local capitalists at Eau Claire, Wis., propose forming a stock company with a capital stock of $50,000 and putting in the Strowger telephone system. George H. Stich of Chicago is interested.

The Minneapolis council has ordered bids advertised for to place the fire and police telephone systems underground.

A. L. Morse has the contract for putting the gas and electric fixtures in the government building at Ashland, Wis.

John Mack of Bismarck, N. D., wants a franchise for an electric light plant at Mandan, N. D. He asks no bonus or special arrangements for street lighting. The aldermen seem favorably disposed.

N. L. P.

PERSONAL.

Herbert H. Brooks, general manger of the American Circular Loom company, Boston, was in Chicago last week.

Hassan H. Wheeler, president of the American District Telegraph company in Brooklyn, died February 2d of quick consumption at his home. He was in his 56th year. He was the organizer of the American District Telegraph company of Brooklyn and continued as its president until his death.

J. Potter, who was for about ten years treasurer of the Brush Electric company of Cleveland, as well as an officer of the Short Railway and Swan Lamp companies, and who sold out his various interests about a year ago, has re-entered the electrical field as president of the Buckeye Electric company of Cleveland.

Lieut. F. B. Badt, for several years manager of the power and mining department of the Chicago office of the General Electric company, has tendered his resignation to take effect with the expiration of his contract March 1st. Lieut. Badt has been identified with electrical work in the West for many years and has a reputation as an engineer of the first rank. He has given especial attention to the subject of power transmission and mining during the last few years and has installed many large plants of this kind.

NEW INCORPORATIONS.

C. & P. Manufacturing company, Brooklyn, N. Y.; capital stock, $20,000; to manufacture and sell machinery and appliances, electrical, steam or otherwise, owned or controlled by Alexander Churchward and William D. Perry; Marshall T. Davidson, Brooklyn, N. Y.

ELECTRIC LIGHTING.

Fire at Marion, O., destroyed the electric light station on January 31st.

There is a movement among the residents of Chicago interested to secure electric lights for Douglas Park.

There is a strong popular movement in Springfield, Ill., in favor of the city owning its own electric lighting plant.

Electric lighting is to be established at Beaver Dam, Wis. Plans and specifications are completed and bids for the work will soon be advertised for.

The Lake Street Elevated Railroad company, Chicago, will erect an electric plant for lighting purposes at 1137–39 West Lake street. It will cost about $7,000.

The contract of the Star Electric company of Dubuque, Ia., with the city for public lighting, has been extended from three to five years. The company will immediately install some additional machinery.

A large isolated arc lighting plant is to be installed in the store of D. Crawford & Co. at St. Louis by the Western Electric company, Two forty-lighters, with switchboard, wiring and lamps, will be furnished.

The Whitehall, N. Y., Electric Light & Power company suffered the loss of its plant last month by fire. The damage done is estimated at $8,000. There was no insurance upon the property, but it is said the company will rebuild at once.

The Palmer & Monson Electric company has formed a new company to be called the Central Massachusetts

Electric company. It is proposed to give service to the towns of Warren, West Warren and West Brimfield, Mass., at once and to other towns later.

Almost every large manufacturer of electric lighting apparatus in the country put in bids for the new municipal electric light plant in Detroit. Samuel F. Hodge & Co. of Detroit were the lowest bidders for the engines. They offer to furnish five triple expansion engines at $20,000 and compound engines at $17,000. The Western Electric company will furnish the dynamos for this plant.

Renewed efforts will be made before the present Massachusetts Legislature to secure an act permitting towns and cities to manufacture gas and electricity for municipal use. The bill provides that a city or town may supply gas or electricity to neighboring towns or cities for light, heat and power. It will be argued that if a municipality may do this, it may also extend the sale of these commodities to the people for private use.

Some trouble has been experienced in Marion, O., between the electric lighting company and the town, in relation to a renewal of the contract for public lighting. The company is continuing the service under the old schedule, pending negotiations with the council, and the place is therefore not in darkness as reported. The price offered the council is $90 a light for 4,000 hours. The offer, it is said, has practically been accepted.

Detroit, Mich., is just now considering the question of electric lighting by towers. There are a number of old Brush towers in use in the city owned by the electric lighting company now supplying the city. The contract with this company expired recently, and the city virtually agreed to buy such towers as it needed at $525 each. It has been discovered that the towers were not erected in a substantial manner, and a new company has been incorporated with a capital stock of $1,000,000 known as the International Electrical Supply & Manufacturing company, the chief object of which is to push a new style of tower invented by Hiram Jones, of Detroit. The company offers the towers to the city at a cheaper rate than the old ones can be purchased. The matter has now virtually become a question of the technical right of the city to withdraw from its agreement with the lighting company, and opinion seems to be about evenly divided. Several members of the board of aldermen threaten to resign if the agreement is not kept.

ELECTRIC RAILWAYS.

It is stated that eastern capitalists have under consideration a project of building an electric railway from Toronto, Ont., to Steubenville.

The Nashville, Tenn., Electric Railway company made an assignment February 3d. It is said that the road has been losing money steadily. Its debts are placed at $900,000.

A meeting of Lake View (Chicago) citizens was held last week in the interest of an electric road. Speeches advocating the immediate acceptance of Mr. Yerkes' offer to put on electric cars were made.

The Ann Arbor, Mich., Electric Railway company's barns burned to the ground a short time ago, only one car being saved. The loss on cars and motors was $20,000, with $11,000 insurance.

It is stated that the Boston, Revere Beach & Lynn Railroad company expects to start the work of equipping its line electrically next spring, but whether it will attach motors to the cars or run electric locomotives is a question yet to be decided.

It is rumored that a project is under consideration to consolidate the Baltimore Traction company, the City Passenger Railway company, the City & Suburban Railroad company, the Central Railway company and the Lake Roland Elevated Railway company, with a capitalization of $12,000,000.

The Cumberland Telephone & Telegraph company has sued the Evansville, Ind., Street Railway company for $60 damages for the alleged burning and destroying of the plaintiff's property in the exchange caused, it is averred, by faulty construction of the defendant's trolley wire on Third street, near Washington, one of the telephone wires coming in contact with the trolley.

A project is under consideration to connect Washington, D. C., with the battlefield of Bull Run by an electric railway. The road, if constructed, will extend from the town of Manassas, about twenty-five miles southwest of Washington, eastward through Fairfax Court House on to Falls Church and thence to Washington, crossing the Potomac on the piers of the aqueduct bridge at Georgetown.

The Avondale street railway sheds and machine shop, Cincinnati, O., burned February 2d, entailing a loss estimated at $175,000. There were seventy-five or eighty cars in the shed; of this number 30 were motor cars. Nearly all of these were new summer cars of the latest design. In the basement were the machine shops and boiler room, and these with their contents were destroyed. The origin of the fire is not known. The insurance is about $150,000.

Capt. Robert McCulloch of the syndicate lines of St. Louis has decided to convert the western extension of the Citizens' cable line into an electric road, beginning at King's Highway. The extension will cover over two miles. All of the contracts for the work have been let, and the wires, rails, etc., have been ordered. The cars will be built at once. Work on the extension will begin as soon as the weather becomes settled. The cost will be all of $150,000.

The street railway company of Charleston, S. C., has accepted, conditionally, an offer of purchase of its franchises made by a syndicate of capitalists of Washington, D. C. This road is now being operated as a horse car line, and is one of the best equipped in the South. There are about 10 miles of road running through the best thoroughfares of the city. It is the purpose of the syndicate to proceed at once to convert the road into an electric system. This will require heavier rails than those used and a reconstruction of the line.

The trial trip cars were run over the Chester, Pa., Darby and Philadelphia trolley line last month, and the road between Chester and Darby is now opened for traffic. The distance is eight miles, and altogether there are 35 miles in the system, which includes the Media and Marcus Hook routes. This is the beginning of a system of electric railways which in a few years will doubtless form a network throughout the semi-urban districts about the city, and upon close and continuous communication with all the towns within a radius of thirty miles of Philadelphia.

The annual meeting of the stockholders of the Rochester, N. Y., Railway company was held at the company's offices January 16th. The following board of directors was chosen: H. Sellers McKee, Murray A. Verner, A. Hart McKee, Horace Magee, Richard W. Clay, Thomas Dewitt Cuyler, Benjamin Graham, John N. Beckley, Frederick Cook, W. S. Kimball, Marsenus H. Briggs, George W. Archer, Jacob Gerling. The following officers were elected: President, John N. Beckley; vice-president, Benjamin Graham; treasurer, Fred P. Allen; secretary, Charles A. Williams.

The New Jersey Railway company, incorporated recently, makes known its plan to build an electric road from New York to Philadelphia. Power stations will be located at Philadelphia, Trenton, Bound Brook, Elizabeth and other points. E. Chamberlain, builder of the Port Reading railroad, is the engineer. Joseph H. Reall, of Bloomfield, is the projector of the enterprise, and associated with him are Charles E. W. Smith, of Morristown; J. H. Baldwin, of Orange; George S. Forbush, of Boston, and Major John Runk. It is given out that the Pennsylvania Railroad is back of the enterprise, and that the franchises have been secured.

The Union Trust company of St. Louis filed suit against the Richmond, Ind., Electric Street Railway company January 21st, asking judgment on the bonds of the company, amounting to $212,000, and asking for the appointment of a receiver to take charge of the road and operate it under the direction of the court. By agreement the present superintendent, A. D. Titsworth, was appointed receiver and immediately executed his bond for $50,000. During the past season the plant has been much improved at a heavy expense, which, together with the hard times, made it unable to meet its obligations. The Richmond electric line was formerly the property of J. C. Shaffer. The line will continue in operation for the present.

TELEGRAPH.

The hard times are felt in the telegraph business in common with other interests. One hundred "extra" men have been dropped by the Western Union Telegraph company in San Francisco.

The contract was let January 5th by President Johnson of the Florence & Cripple Creek Railway company to the Western Union Telegraph company for the construction of a telegraph line along the line of the Florence & Cripple Creek railroad from Florence to Cripple Creek, Colo.

Fourteen thousand primary cells formerly used in the Western Union Telegraph company's Boston office have been replaced recently by nineteen dynamos. It is claimed that the saving by this change will amount to between 50 and 60 per cent. It is expected that ten more machines will be added soon.

Strong pressure is being brought to bear upon the Canadian government by business men in Canada to induce it to grant the extension of the Halifax-Bermudas cable to Jamaica. The leading shippers hold that the extension of the cable to Jamaica and other islands is absolutely essential to the development of Canadian trade. Four steamers a month are now running, but business is very much restricted by the high telegraph rates charged, and by the fact that the daily quotations of prices published in the West Indian newspapers are received from New York. The extension of the Bermudas cable would make it possible for the Canadian market prices to be published in the West Indies side by side with the American quotations; and with the advantage of cheaper cable rates Canadian trade would be largely increased.

According to the English press, the New Caledonia cable is not securing the patronage that its projectors anticipated, and the enterprise is receiving practically no encouragement from the colonial authorities. This may be due to the influence exerted by the home government. At any rate the English and Canadian papers seem elated over the prospect of the failure of the French enterprise. The *Canadian Gazette*, for instance, says: "The New Caledonia cable does not seem to be of much use, now it has been secured at the expense of British interests in the Pacific. The Melbourne *Age* tells us that though the cable was opened on October 19th the business done between New South Wales and New Caledonia during the three weeks in which the cable was in operation was only 45 cablegrams each way, while ht business from Victoria over this much vaunted first link in a trans-Pacific cable was one telegram each way. The colonial governments of Queensland and New South Wale must by this time realize how little they have reaped by their encouragement of a foreign concern and the consequent desertion of the 'principle of inter-colonial cohesion. Meanwhile the oppression of the cable monopoly under which the Australian colonies labor has been emphasized by Sir Thomas McIlwraith of the Queensland executive. Before leaving Hong Kong on November 29th for Canada, Sir Thomas expressed his belief that telegrams could be sent from Australia to England for 1s. 6d. with profit. 'What is wanted,' he declared, 'is an independent line not touching Asia, nor depending on the Eastern Extension company, but competing with it.' The Queensland merchants who now have the pleasure of paying 9s. 5d. a word, will, no doubt, as the *British Australasian* suggests, be enthusiastic in urging Sir Thomas on in his efforts to secure an all British route for cables at 1s. 6d. a word." The London *Electrical Review* says: "It is hardly necessary to add that not only Queenslanders, but merchants on this side also, carrying on trade with that Australian province, would equally as enthusiastically welcome any endeavors to replace the current exorbitant tariff of about 9s. 5d. per word by a more reasonable one, though it might not be so low as the figure mentioned, *i. e.*, 1s. 6d."

TELEPHONE.

On January 21st the Louisville, Ky., telephone exchange was damaged by fire to the extent of $80,000, partly covered by insurance.

A telephone exchange has been established at Eupen, Germany. Communication will also be available between Eupen and Aix-la-Chapelle.

Representative Bliss of West Springfield, Mass., offered his bill in the House January 23d, which provides for the assessment of a tax to the American Bell Telephone company on all shares of stock in branch companies outside the commonwealth, of which the Bell company is now said to own $22,000,000.

An ordinance was introduced in the Philadelphia common council, January 18th, granting permission to the Drawbaugh Telephone & Telegraph company of Philadelphia, which was recently organized with a capital stock of $2,000,000, to construct and operate a system of wires and cables within the city limits. This action is the beginning of an effort to introduce a rival telephone service upon the expiration of the Bell company's patents.

The common council of Oconto, Wis., met in special session January 30th for the purpose of conferring with G. M. Jarvis, of Chicago, who is looking for a location to erect a plant for the manufacture of telephones. One of his propositions is that in consideration of the city's giving him a bonus of $10,000 he will build a $30,000 telephone factory, employ from seventy-five to a hundred men and women, and at the expiration of five years, should he have failed in his undertaking, the $10,000 bonus will be returned to the city.

A correspondent of an English electrical journal, in describing a recent visit to a large supply house in London, says: "Immediately after entering the office I heard a muffled voice exclaim, 'A happy New Year to you,' and on looking round I beheld a full-sized figure of a jolly jack tar standing at 'salute.' Feeling sure that the good wish emanated from the wax model, I replied, 'Same to you, old fellow, and to all associated with electric science.' The figure contained a loud-speaking telephone receiver and a well designed carbon-transmitter in communication with similar apparatus in an adjoining room."

Stockholders of the Chicago Telephone company and also those of the Central Union Telephone company elected boards of directors recently. Those elected by the Chicago company were: John De Koven, John B. Drake, Arthur G. Fuller, John E. Hudson, J. Russell Jones, Robert T. Lincoln, C. E. Perkins, Henry B. Stone and Norman Williams. The Central Union company elected these directors: C. H. Brownell, R. C. Clowry, C. R. Cummings, Arthur G. Fuller, F. H. Griggs, John E. Hudson, J. Russell Jones, M. G. Kellogg, Henry B. Stone, John F. Wallick and Norman Williams. Neither board elected officers. The latter will be chosen later.

MISCELLANEOUS.

A petition is being circulated to send to the provincial Legislature petitioning that body to grant permission to Carlton Place, Que., to allow an exemption from taxes, and grant a bonus of $20,000 to the Royal Electric company of Montreal. The company will guarantee to employ at least 100 hands for a period of 15 years.

F. W. Doane, the city engineer of Halifax, N. S., has been visiting several cities in the United States with a view of deciding as to the best system of rapid transit. He recommended the electric trolley system, and it is probable that before long some scheme will be put forward for constructing an electric street railway for Halifax.

The Board of Electrical Control of New York met last week in the mayor's office and rejected for the second time the application of the New York Light, Heat & Power company for permission to lay a subway on Nassau street from Spruce street to Maiden Lane. The application was refused on the ground that Nassau street has been recently repaved.

The electrical engineers of Minneapolis and St. Paul have organized a society under the name of the Twin City Electrical Engineers. George Lintner, Minneapolis, is acting president, and J. H. Dean, St. Paul, acting secretary. At the initial meeting Henry A. Stuckey of Minneapolis read a paper on the "Causes of Fires and How to Remedy Them."

Articles of incorporation of the Jordan River Electric Generating company have been filed at Salt Lake City. The company is incorporated for $500,000, and is to exist

or a term of 50 years unless sooner dissolved. The force utilized will be the water running over certain dams in the Utah and Salt Lake canal and the Jordan canal, where there will be furnished about 20,000 cubic inches of water.

A plan has been submitted to the Philadelphia council in the interest of burying the wires. The plan came in the form of an ordinance granting the American Subway company permission to build underground conduits for wires. The plan of the company is to construct subways of sufficient dimensions to accommodate all the wires for telegraph, telephone, electric light and the city's police and fire alarm service. By the terms of the ordinance the city will have complete control over the subways.

TRADE NEWS.

The Western Electric company has sold to the Detroit Foundry Equipment company two 240 volt generators of 50 kilowatts capacity each and eight motors for use in a power transmission plant in a factory at Harvey, Ill.

Sargent & Lundy, electrical engineers and western agents for the Crocker-Wheeler motors, have removed their offices from the fourteenth floor of the Monadnock block, Chicago, to the ground floor of the same building. As the new office is numbered 13 and as the change was made on Friday, the firm looks forward to a greatly increased business in its new quarters.

McDougall, Lucas & Co., the Rookery, Chicago, have issued a little book calling attention to the electrical apparatus and specialties they intend handling. These include the Climax iron clad rheostats and Kester arc lamps for either direct or alternating currents. Both these articles have many points of merit, and the new comer in the field will doubtless meet with success in pushing them.

The Joseph Dixon Crucible company, Jersey City, N. J., has issued the second edition of "Graphite as a Lubricant." The value of graphite as an accessory for engineers and machinists is scientifically and practically considered. The book advances a scientific opinion of graphite and the advantages of its uses. The first edition received marked attention, and doubtless the edition just issued will have as wide a field.

The C. & C. Electric company, New York, has issued an exceedingly interesting and valuable book containing some facts on the relative efficiency and economy of electrical power transmission. The book is in no way a catalogue or circular of the C. & C. Electric company, but is a careful comparison of the electrical system of power transmission with other systems. The contents for the most part consist of abstracts of papers read before the Association of Engineers, composed of graduates of the College of Liege, Belgium, by Leon Castermans, managing director of the government rifle factory at Herstal, Belgium, and Felix Mélotte, engineer for the International Electrical company at Herstal. The conclusions reached by the two writers are so unqualifiedly favorable to electric transmission as against mechanical means and the facts and figures are of so convincing a character as to leave little doubt in the minds of persons hesitating between the electrical and mechanical mode of power transmission. The book is well worthy of careful study. General Manager Hall of New York is pushing the sale of the C. & C. machines, and is keeping the business of his company well in the front.

BUSINESS.

J. Holt Gates, western manager of the Waddell-Entz company, reports the sale by the Chicago office of two Waddell-Entz 600 light dynamos directly connected to Ideal engines, to the Wayne County Poor House, Detroit, Mich.

C. E. Wilson, well known to the electrical fraternity of the West, has accepted a position as manager of the Chicago office of the Consolidated Engineering company of St. Louis. Mr. Wilson is located at 84 Adam street. He reports the outlook for business as excellent.

The Palermo Mica company, 27 Peck slip, New York, is prepared to furnish a superior quality of silver amber sheet mica of any size desired. This mica is carefully selected and cleaned and closely trimmed. The company is sending to the trade a price list of pure New Hampshire electrical mica.

Frederick L. Merrill, electrical engineer and contractor, the Rookery, Chicago, is sending to the trade a circular letter from George F. Durant, general manager of the Bell Telephone company of Missouri, certifying to the successful operation of the storage battery plant with a capacity of 70,000 watt hours installed by Mr. Merrill last February. A description of this plant is presented elsewhere in this issue.

The Electric Appliance company, Chicago, has been keeping a large extra force busy for the past few weeks taking care of the large shipments which are being received and placed in stock in preparation for spring business. The company is materially increasing its storage and shipping facilities, and when the alterations are completed the arrangements for promptly handling large orders will be much improved. Several carloads of wire, cross-arms and insulators have been placed in stock during the past week, and considerably more is expected.

The Standard Paint company, manufacturer of the P. & B. compounds, of New York, has formed an alliance which cannot prove but successful, in selecting the Metropolitan Electric Company of Chicago as its general western agents The P. & B. compounds have became so well known in the electrical field that the Metropolitan company will not find it necessary to introduce them and the company is certainly to be congratulated upon securing such an agency. William Weierbach of New York will hereafter represent the Standard Paint company in Chicago, with offices at 871 the Rookery.

Horne & Martin, 505 Home Insurance building, Chicago, general agents of the National Electric company of Eau Claire, Wis., have appointed the following named agents: General eastern agent, James F. Kelly, 906 Temple Court, New York; Pennsylvania agent, Pennsylvania Electrical Engineering company, Penn. Mutual building, Philadelphia; agent for Missouri, Arkansas, Southern Iowa and Southern Illinois, St. Louis Electric Light Supply company, St. Louis; Detroit agent, Peninsular Electrical & Engineering company; Dallas agent, O. J. Gorman & Co., Dallas, Tex. The Boston agent has not yet been appointed. The Kansas City and St. Paul territories are still vacant.

General Manager H. T. Johnson of the Manhattan Electrical Supply company, 36 Cortlandt street, New York, in a circular, states that after February 15th his company will announce telephonic devices to replace those covered by the Bell company's patent on magneto bells with automatic switches changed by the weight of a telephone receiver, and on the shunt of the generator armature being automatically cut out by turning the crank that revolves the generator. Since the expiration of the Bell Telephone company's patent this concern has been obliged to hire extra help and work over time to fill the increase in orders for the company's Mesco dry battery.

A patent which, the company claims, controls broadly all commercial forms of enamel rheostats and heaters has recently been issued to the Carpenter Enamel Rheostat company as the assignee of C. E. Carpenter. This company will immediately put upon the market a full line of electrically heated appliances, such as soldering irons, flat-irons, glue pots and various kinds of electrically heated tools as well as electric cooking utensils, such as chafing dishes, coffee pots, ovens, broilers, etc. The theater dimmers and field rheostats of this company are also recognized as standard articles. The following agencies of the company have recently been established: Walker & Kepler, Philadelphia; Sargent & Lundy, Chicago; Owen Ford, St. Louis; William Oswald, New Orleans.

The Metropolitan Electric company, Chicago, has recently taken the general sales agency for the P. & B. specialties, which include paint, armature varnish, electrical compounds, tape and Chatterton's compound. A large stock will be carried at the store and warerooms, 186-188 Fifth avenue, and prices will be made the same as from the factory. The company, which is also the general western agent for N. I. R. wire and cables, has recently had some very satisfactory tests from two of the largest buildings in Chicago, in which the wire is used. The N. I. R. factory has been enlarged in its line of products, and electrolier wire, lamp cord, rubber and friction tape are now being manufactured. A full stock of these goods will be carried by the Metropolitan Electric company.

ELECTRICAL PATENTS.

Issued January 30, 1894.

513,482. Anti-inductive Conductor. Horace F. Chick, Watertown, Mass.

513,507. Utilizing Electric Motors for Operating Machinery. Carl Hoffmann and Ernst Richter, Berlin, Germany.

513,526. Fire Alarm Telegraph System. Michael J. O'Sullivan, Baltimore, Md.

513,533. Commutator. George A. Rollins, Chicago, Ill.

513,534. Signaling System for Telephone Circuits. John I. Sabin and William Hampton, San Francisco, Cal.

The telephone lines are normally open at the subscriber's station, and are in circuit at the central station with a local battery and indicator, so that when the circuit at the subscriber's station is closed the battery circuit is completed, and the indicator is actuated to inform the operator that the subscriber desires a connection.

513,537. Signaling System for Telephone Trunk Lines. Charles E. Scribner, Chicago, Ill.

The signaling circuit is extended to each of the answering boards containing a connection socket of the trunk line, a signaling instrument and means for closing the local circuit being provided in connection with each of the connection sockets. All the signaling instruments upon the different answering boards are simultaneously actuated or caused to respond when the local circuit is closed, so that they constitute signals upon all the answering boards to indicate that the corresponding trunk line is in use.

513,545. Circuit Controller for Regulators. Barton B. Ward, New York, N. Y.

513,564. Electric Wire Cleat or Holder. Albert W. Fuller, Saugus, Mass.

513,566. Trolley Wire Finder. Edward Gale, Peoria, Ill.

513,587. Electro-mechanical Device for Bells, Etc. William O. Meissner, Chicago, Ill.

513,592. Annunciator. Joseph H. McEvoy, Waterbury, Conn.

513,593. Electric Bell. Joseph H. McEvoy, Waterbury, Conn.

513,598. Starter and Propeller for Electric Cars. Ernest Schmitz and James Mendenhall, Chicago, Ill.

513,599. Gearing for Electric Locomotives. George W. Swartz, Florence, Ala.

513,601. Mechanism for Controlling Engines. Benjamin F. Teal, Chicago, Ill.

513,602. Electric Furnace. Elihu Thomson, Lynn, Mass.

513,611. Dynamo Brush. Wilfrid H. Fleming, Bayonne, N. J.

The brush consists of successive layers of wire gauze formed into the desired shape and then compacted by pressure.

513,612. Electrical Registering Device. Friedrich von Heffner-Alteneck, Berlin, Germany.

513,615. Method of Operating Electric Loom Shuttles. Levi W. Lombard, Saco, Me.

513,626. Automatic Rheostat. Carson J. Sturgeon, Erie, Pa.

513,630. Detachable Electrical Wire Holding Device. Cornelius Beard, Brookline, Mass.

513,661. Electrolytic Cell. Claude T. J. Vautin, London, Eng.

513,720. Telephone. Herbert S. Page, Somerville, Mass.

The diaphragm is of glass, one of its surfaces being platinized, the other carbonized. The platinized surface rests against the platinum electrode of a Blake transmitter, the circuit being from the carbonized surface to the platinized surface, from which two paths are provided to the platinum point, one through the electrode itself and the other through the spring carrying the platinum electrode. In the rear of the diaphragm is pivoted a thin iron diaphragm, near the surface of which are located the poles of a horse-shoe magnet, the magnet and iron diaphragm serving to dampen the vibrations of the glass diaphragm.

513,725. Electric Arc Lamp. Frank A. Perret, Brooklyn, N. Y.

513,729. Telephone Transmitter. Francis H. Richards, Hartford, Conn.

513,730. Telephone Transmitter. Francis H. Richards, Hartford, Conn.

The transmitter comprises a diaphragm carrying an electrode composed of two pieces, one of conducting, the other of non-conducting material. The compound electrode thus formed rubs against the surface of a conducting electrode stationarily mounted, and as the diaphragm vibrates the variation of the area of the conducting portion of the compound electrode in contact with the stationary electrode varies the resistance of the circuit to produce the current undulations, without varying the pressure between the electrode in contact.

513,745. Switch Bar. Franklin A. Weller, Boston, Mass.

513,775. Annunciator. Manious Garl, Akron, O.

513,796. Automatic Circuit Closer. Henry Lewers, Carson City, Nev.

513,829. Electric Alarm. David S. Schureman, Rockford, Ill.

513,839. System of Electrical Distribution. Charles H. Talmage, St. Louis, Mo.

513,846. Trolley Pole Stand. Gustaf Valley, Cleveland, O.

513,847. Trolley Pole Stand. Gustaf Valley, Cleveland, O.

513,850. Electrical Theatrical Appliance. Henry E. Waite, New York, N. Y.

513,859. Electrically Propelled Drive Wheel. Carl G. Anderson, Lynn, Mass.

513,894. Sectional Electric Railway. George W. Demmick, Lynn, Mass.

513,895. Power Transmitting Mechanism for Electric Locomotives. Mark W. Dewey, Syracuse, N. Y.

513,910. Storage Battery. George B. Fraley, San Francisco, Cal.

513,921. Electric Arc Lamp. Manuel R. Gutierrez and Milton T. Thompson, Jalapa, Mex.

513,948. Automatic Damper Regulator. Hosea F. Maxim, Norfolk, Va.

513,949. Connector for Electric Wires. Edward H. Munson, New Britain, Conn.

513,950. Insulated Rail Chair. Louis McCarthy, Boston, Mass.

513,951. Incandescent Lamp Socket. James McFarlane and William B. Edgar, Glasgow, Scotland.

513,956. Annunciator. Frederick W. Ross, Boston, Mass.

513,960. Automatic Telephone Switch. Augustus C. Wheat, Chicago, Ill.

11,400. System of Electrical Distribution. William Stanley, Jr., and John F. Kelly, Pittsfield, Mass.

The system comprises a generator of alternating currents of constant strength, primary coils of a transformer connected in circuit with the generator, the secondary coils in circuit with the working circuit, and a condenser in series with the secondary circuit, and adjusted to neutralize the electromotive force of self-induction in the secondary circuits.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents expiring during the week ending January 30, 1894:

186,755. Magnetic Holders for Feeding Screw and Other Blanks. E. E. Quinby, Orange, N. J.

186,787. Electric Telegraphy. A. G. Bell, Boston, Mass.

186,819. Fire Alarm Signal Boxes. G. Floyd, Cincinnati, O.

186,877. Lightning Rod Couplings. W S. Reyburn and F. J. Martin, Philadelphia, Pa.

186,887. Fire and Police Alarm Signal Apparatus. C. Selden, Cincinnati, O.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, FEBRUARY 17, 1894. No. 7

Handling Steel Products by Electrical Power.

At the present time no department of the electrical industry presents a more favorable outlook than that of power transmission for large factories. Where power is needed in several buildings of a large manufacturing concern, or even in the case of one large building, it is found that greater economy and convenience can be attained by the establishment of a central generating station, transmitting the power by electricity and utilizing it with motors. Long lines of shafting or distinct steam plants are thus done away with, and in either case a marked saving can usually be effected, while the driven machinery can ordinarily be operated with less exertion on the part of the workman. Where electrical power is thus used ingenious adaptations of motors to do work not usually associated with electricity are frequently found. A case in point is that of the electrically operated machinery at the Joliet, Ill., works of the Illinois Steel company, illustrated by the accompanying pictures.

The illustration on this page shows the apparatus employed in loading the steel billets onto flat cars. After coming from the mill the billets are piled up in the yard until wanted for shipment. The loading of the cars is accomplished with the minimum amount of manual labor by the employment of the electrically operated machinery shown. The billets are delivered to a long line of rollers, partly shown at the left in the illustration, and are thus carried along until they strike a deflecting plate, which causes them to fall on an endless moving apron, set on an incline, at prominently shown in the picture. This apron first elevates and then drops the billets on the car to be loaded, which is on a depressed railroad track on the farther side. This loading machine is driven by a 25 horse power 500 volt motor, as shown, the controlling switch and rheostat being conveniently placed in a tiny switch-house. It works well and has resulted in a great saving in labor.

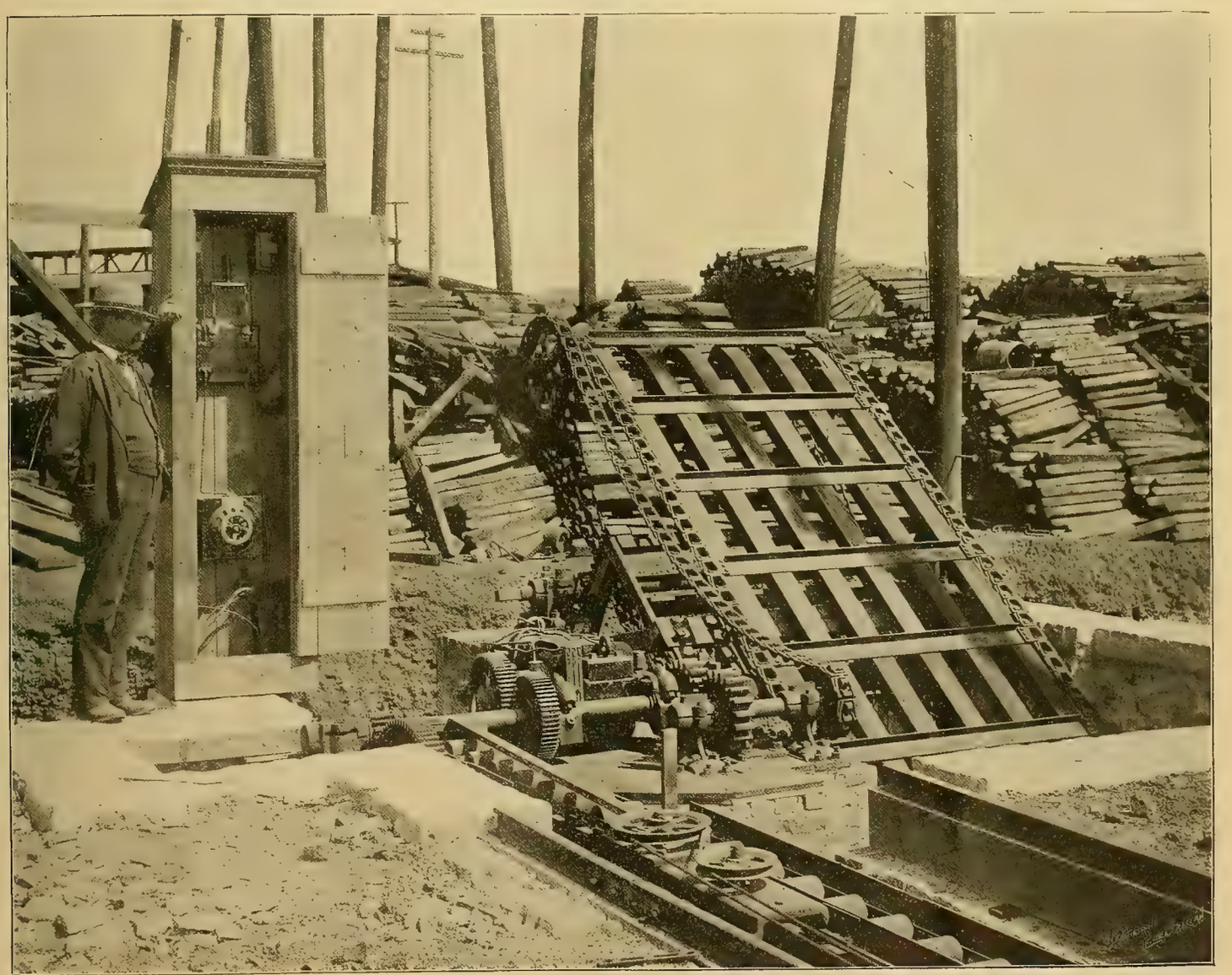


FIG. 1. HANDLING STEEL PRODUCTS BY ELECTRICAL POWER.—APPARATUS FOR LOADING CARS.

An exceptionally interesting motor application is that shown in Fig. 2, which illustrates the electro-hydraulic ingot charging machines used in the heating room. There are two of these machines, and each is practically a transfer table 35 feet long and 15 feet wide running on two tracks. In the center of this table, running lengthwise, is an adjustable frame, which is capable of being raised or lowered by hydraulic pressure from cylinders on either side. Running on this frame is a carriage carrying a heavy pair of jaws studded with steel teeth for gripping the ingot. These jaws can be opened, closed, raised or lowered, drawn in or out, at the pleasure of the operator, who is stationed on an elevated platform near the upright tanks, by means of levers which control the water pressure. Of the two tanks shown in the illustration one is the pressure tank, capable of containing a pressure of 500 pounds per square inch, while the other is a storage tank, into which the water is discharged after being released from the cylinders. This pressure is obtained by a triplex pump driven by a 25 horse power motor, so controlled that when the pressure reaches 500 pounds the motor is stopped automatically, but as soon as it falls below this pressure the motor is again started, thereby keeping a uniform pressure in the tank. The traversing motion on the tracks is accomplished by a 15 horse power motor of the railway type geared directly to one of the axles of the track wheel.

The operation of the machine is as follows. An ingot is placed on the "buggy" which runs on a track in front of the heating ovens, and stopped in front of the oven to be charged. The operator on the charging machine pulls a cord, and by means of compressed air the heavy iron door of the oven is raised. He then brings the machine to a position behind the ingot, and, by means of the levers, opens the jaws, grasps the ingot, which has been standing, in a vertical position, and allows it to swing into a horizontal position. Then, by a second lever, he slides the ingot into the oven, raising or lowering it by a third lever,

as the case may require. Should the ingot be heated on one side and it be desired to turn it over, it is gripped by the jaws, and by another lever the jaws are rotated so as to completely turn it over. The method of withdrawing an ingot is the same in reverse order. To move the table from one oven to another a lever controlling the rheostat operates the traversing motor.

The heated ingot on being withdrawn from the oven is placed on the "buggy" and drawn in line with the rolls, where it is reduced in size and cut up into billets, which fall on an endless chain of rolls, which are operated by an independent motor of 25 horse power capacity. These rolls rise to an elevated trestle, which runs through the mill out into the yard for a distance of about 600 feet. By means of a deflecting arm these billets are distributed to any point in the yard.

All of the motors are wound for 500 volts. The current for the charging machines is obtained from two overhead trolley wires, from which it is taken by two trolley wheels, as shown in Fig. 2. Except the trolley wires, all the conductors are laid in lead-covered cables.

Operating Elevators by Electric Motors.

In the accompanying diagram is shown an arrangement for controlling electric motors in the operation of elevators, designed by John D. Ihlder of Yonkers, N. Y. The inventor claims that compound electric motors, especially in the operation of elevators, have many advantages, but are still open to some objections. It is desirable to utilize the compound wound electric motor in starting the load and especially in connection with elevators which have to be started and stopped at frequent intervals. After the motor has started with its load it is desirable to change its circuits and connections so that it shall operate practically as a shunt wound motor, which has been found to be best adapted for this purpose, running at a uniform rate of speed, besides being practically self-regulating and economical.

By reference to the cut the arrangement of the circuits will be understood. A represents the armature of the motor, BB' the brushes of the motor, the field coils being indicated as wound on the motor, while C is a circuit reverser for the armature. The characters plus (+) and minus (—) represent the lead or main lines of the electric circuit supplying current to the motor, and the conductor D shown in the heavy lines, including the convolutions D^1 D^2, represents the long shunt field magnet coils of the compound wound motor.

The armature circuit, which normally includes the series field magnet coils, is provided with an auxiliary resistance R, which is preferably controlled by an electromagnetic device S, included in the armature circuit, and which controls a contact arm T, bearing on the contact plates of the auxiliary resistance R. One end of the auxiliary resistance, as the block 6, is connected to the coil S and to the next succeeding block 5, suitable resistance r being interposed between the blocks. The remaining blocks of the auxiliary resistanee are similarly connected.

The block d is connected by a conductor E with the series field magnet coils E^1 E^2 of the motor, and thence leading from these coils, by the conductor E^3, the circuit passes to the contact arm C^1 of the circuit reverser, thence to the contact arm C^2, to the brush B of the armature, through the coils thereof to the brush B^1, thence by the conductor F to the contact arm C^3, and out by the contact arm C^4, by conductor F^1, to line. Of course it will be understood that if the position of the current reverser C is changed, the circuit will be the same, except that the current will pass through the armature coils in the opposite direction, in the manner well understood.

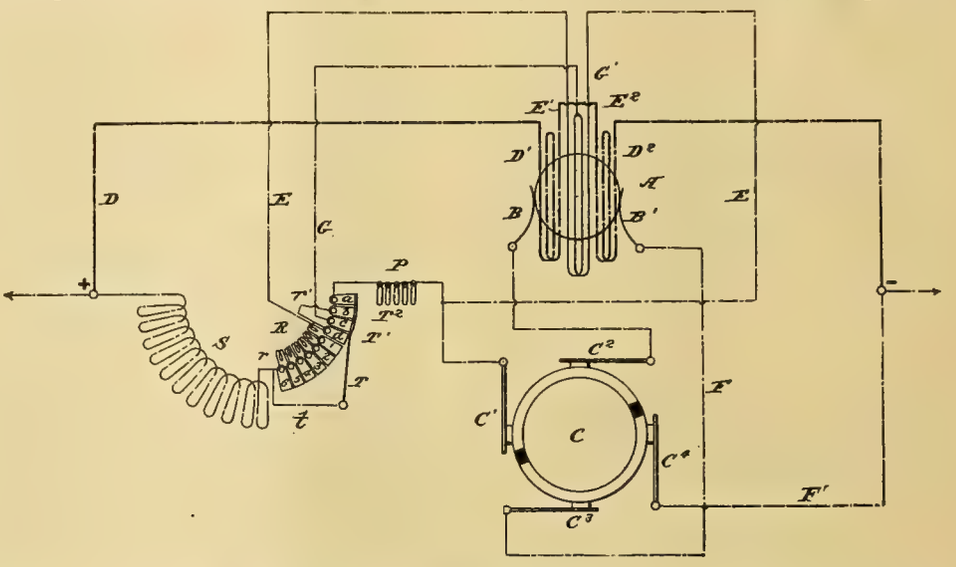
The contact block c of the auxiliary resistance is shown as connected by the conductor G with the central portion G^1 of the series field magnet coils of the motor, so that only one-half of those coils are included in the circuit of this contact block.

The contact block b is shown as connected with the contact block d of the auxiliary resistance by a conductor r', of practically no resistance. The contact block a is connected directly with the contact arm C^1, and may include an adjustable resistance P, and it will be seen that this resistance is arranged in the armature circuit in parallel or multiple arc with the series field magnet coils or a portion of them.

The contact arm T, which is connected by conductor t with the armature circuit as indicated, and preferably with the terminal of the electromagnetic coil S, is provided with two blocks T^1, T^2, insulated from each other, the block T^2 being preferably arranged so as to make contact with two adjacent contact blocks of the auxiliary resistance.

With this arrangement of circuits it will be seen that when the circuit is closed through the motor in the usual way a portion of the current passes through the conductor D, including the shunt field magnet coils of the motor, while another portion passes through the coils of the electromagnetic device S, causing the contact arm T to assume such a position that it will bear on the contact block 5 and include the auxiliary resistance in the armature circuit and thereby prevent too great a flow of current through the armature on starting, and it will be observed also that the current, after passing through the resistance, also passes through the conductor E, including the series field magnet coils of the motor, thereby causing the motor to operate purely as a compound wound motor for the purpose of getting the greatest torque in starting and overcoming the inertia of the load. As soon, however, as the armature of the motor begins to operate, the counter electromotive force tends to reduce the amount of current flowing through the armature, weakening the magnetic effect of the coils of the electromagnetic device S, and the auxiliary resistances are gradually cut out of circuit. When the contact arm T^1 reaches the contact block 2 the insulated portion T^2 of the contact arm would short circuit resistance blocks 1 and d, and the current would then flow through both coils E^1 E^2 of the series field magnet coils. When the contact block t^1 reaches contact block 1 the resistance r, between blocks 1 and d, would be included in the circuit, and the insulated contact block T^2 would short-circuit blocks d and c, practically cutting out of circuit the section E^1 of the field magnet coils, and the current would pass through the conductor G, and the section E^2 of the field magnet coils. When the contact T' reaches the block c the current would pass through the conductor G, through the coils E^2, in the same direction as before, while a portion of it would pass through the coils E^1 of the series field magnet coil, but in an opposite direction, and thence returning by the conductor E to the block d and conductor r' to the block B, through the contact T^2, to the block a, and thence pass through the parallel circuit P to the armature. In this condition it will be observed that part of the field magnet coils in series with the armature are energized in one direction, and part in another, so that they are in opposition to each other, and by adjusting the parallel resistance P the amount of current flowing in each circuit can readily be determined, or if, perchance, the resistance P is entirely cut out, the two sections of the series field magnet coils would be energized in opposition to each other, but under no circumstances are all the series field magnet coils short-circuited or cut out of circuit.

It will thus be seen that by arranging the circuits as described, various conditions of operation of the motor can be automatically accomplished, and by properly adjusting the relative relations of the circuits the motor may be adapted to operate practically as an ordinary shunt motor for running under normal conditions. Moreover, as the series field magnet coils are never entirely cut out of circuit, it is claimed, there is no danger of sparking, and as the position of the contact arm 10 is controlled by the electromagnetic device S in the armature circuit its operation is automatic and self regulating.



OPERATING ELEVATORS BY ELECTRIC MOTORS.

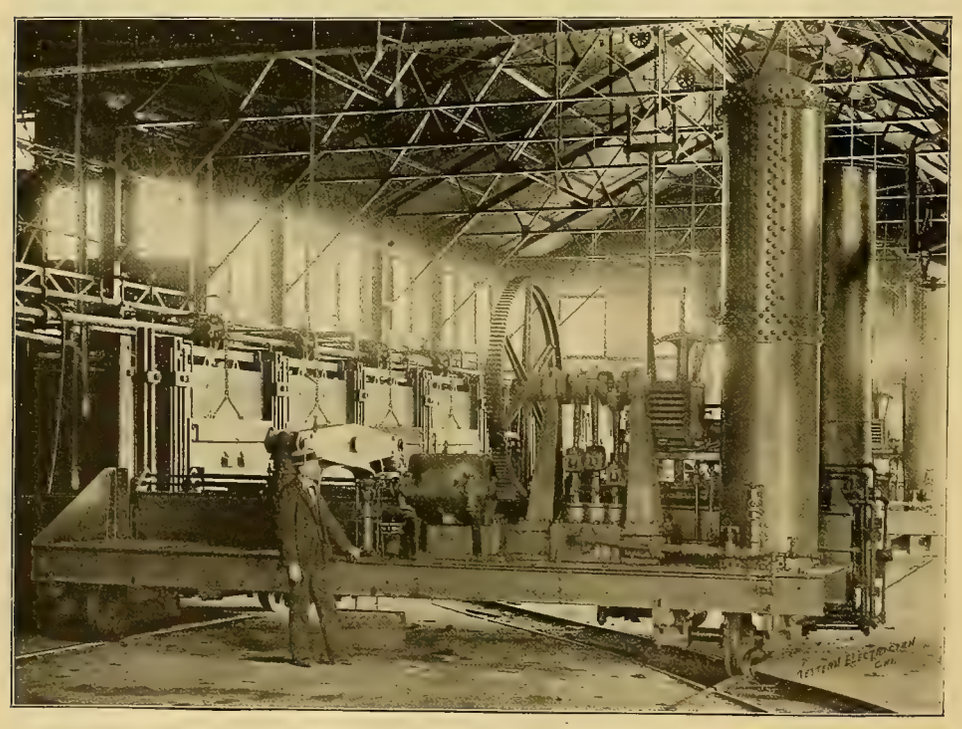


FIG. 2. HANDLING STEEL PRODUCTS BY ELECTRICAL POWER.—ELECTRO-HYDRAULIC INGOT CHARGING MACHINE.

William Carson and N. H. Falk are preparing to put an electric plant in the town of Arcata, Cal. Forty arc and 1,200 incandescent lights will be installed.

Fire did about a $1,000 worth of damage to the lighting plant owned by Topeka, Kan., the first of the month. The service was not interrupted to any considerable extent.

Recent Inventions of Nikola Tesla.

In conducting his experiments with alternating currents of high frequency and high potential Mr. Tesla has found it necessary to devise new forms of apparatus to produce and control the current with which he has achieved such interesting results. Three of the latest improvements of this description, all patented, are illustrated by the accompanying cuts.

In Fig. 1 is shown a new device for producing the

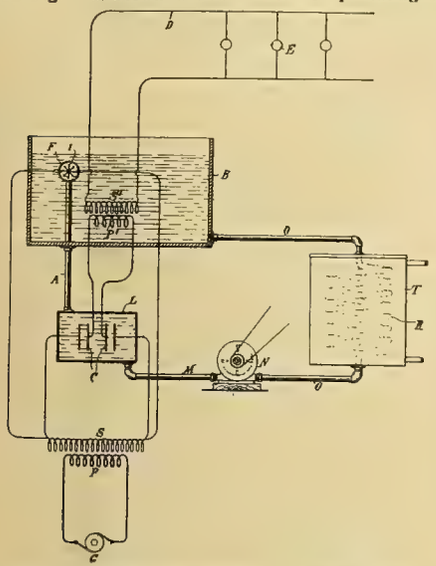
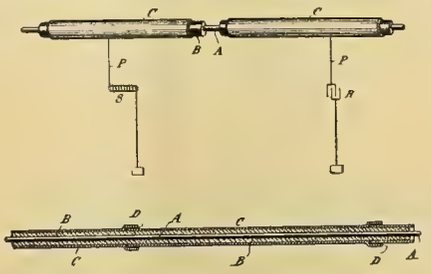


FIG. 1. RECENT INVENTIONS OF NIKOLA TESLA.

intermittent discharge across a break in the circuit, designed to replace the air gap in the production of alternating currents of high frequency. The advantages of this method lie in the fact that the disruptive discharge takes place in oil insulation and that the rate of discharge is under absolute control, obviating any tendency to a continuity of the arc or discharge. The inventor also takes advantage of the presence of the oil to secure a more effective insulation for the converter coils and condenser plates which are necessary in apparatus of this character. By reference to the diagram the method of operation will be readily understood. *G* is an ordinary alternator, connected to the primary winding *P* of a transformer, of which *S* is the secondary. To the latter are connected the plates of a condenser *C*, and at *F* is a break in the circuit at which occurs the disruptive discharge. In the secondary circuit, in series with the condenser, is a primary coil *P'* with which is associated a secondary *S'*, the latter constituting the ultimate source of current for the working circuit *D*, with which are connected translating devices *E*. By the disruptive discharge between the terminals at *I* the condenser is charged and discharged, producing a current of enormous frequency. The unique feature of the apparatus is the means by which the disruptive discharge is accomplished by interposing a series of rotating conductors *I* between the terminals. *A* is a pipe that leads into a tank *B*. To the end of this tube is secured an extension *F* of insulating material and the two terminals are caused to project through it. Within the extension are two cross-bars which afford bearings for the spindle of a small metallic turbine *I*, the blades of which, as the turbine revolves, bridge the space between the two terminals, nearly or quite touching the terminals in their movement. If the tank *B* be filled with oil and the latter is drawn off or permitted to flow off through the tube *A*, the turbine will be rotated by the flow, the rate of rotation being dependent upon the rate of flow. By this means the arc or discharge is periodically established through a flow of oil, which secures the object sought to be attained. A glance at the cut will show the manner of insulating in oil the second transformer *P' S'* in the tank *B* and the condenser in a receptacle *L*. A small rotary pump *N* causes the oil to circulate, and, of course, the rate of the disruptive discharge is regulated by the speed of this pump. The jacket *T* and coil *R* provide a means for cooling the oil if necessary.

A simple plan to prevent the dissipation of current on electrical conductors carrying excessively high potentials is shown in Figs. 2 and 3. Mr. Tesla has found that the use of grounded conducting sheaths is usually attended by a serious loss of energy. He therefore maintains the sheath either entirely isolated or connected directly or inductively to the ground through a path which will practically prevent the passage of current over it. He divides the screen into short lengths, much shorter than the wave lengths of the current used, so that the grounding of any one of such lengths or the approach thereto of a large body will result in an inappreciable loss, or at most a small local draining of the energy, while the tendency of currents to flow between different points in the sheath is effectually overcome. The function of the sheath as a static screen for preventing the dissipation of the electric energy, however, requires for its complete effectiveness an uninterrupted conducting partition or screen around the conductor. This requirement is met by causing the ends of the insulated sections to overlap, interposing a suitable insulating material between the overlapping portions. In the cuts *A* is the conductor, *B* the insulation, *C* the sheathing divided into overlapping sections insulated from one another by the material *D*. The ground connections are illustrated in Fig. 2. Mr. Tesla obtains the beneficial results of an earth connection, while preventing the generally serious loss that would occur in the use of such currents, by providing between the sheath and the ground a path *P* of very high ohmic resistance or one containing a self-induction coil *S* properly determined with respect to the existing conditions, so that it will effect the described result, or a condenser of very small capacity as shown at *R*. In such cases the sheathing or screen for practical purposes may be regarded as isolated from the ground, since by the character of the connection employed no appreciable loss results from the passage of current from the sheath to the ground.

An improved incandescent lamp for use on circuits carrying alternating currents of high potential and frequency is the third invention, the object of which is to prevent dissipation from the conductors in the lamp. This is accomplished by surrounding the leading-in and supporting conductors with a conductor which acts as a static screen. By this means the light-giving body or button which lies beyond the influence of the screen is quickly and efficiently brought to and maintained at higher incandescence, by reason of the fact that the electrical action to which the incandescence is due is confined mainly to the button. *A* is a glass globe of the usual form, in the base of which is sealed a very thin conducting wire *B*, passing up through a stem of glass or other refractory insulator *C*. To the upper or inner end of this



FIGS 2 AND 3. RECENT INVENTIONS OF NIKOLA TESLA.

wire is united, as by means of a mass of carbon paste *D*, a carbon or other refractory stem *E*, that supports or carries a small button of carbon or other suitable substance *F*. Over the stem *C* is passed a metallic tube *G*. Mr. Tesla recommends for this purpose a very thin cylinder or tube of aluminum, and it should entirely surround all parts of the conductor within the globe except the button itself, extending to or nearly up to the point of union of the stem *E* with the button *F*. Such a device, by reason of its electrostatic action, reduces the loss of energy supplied to the bulb, preventing its radiation or dissipation into space except through the exposed or unprotected button. The tube or screen *G* is entirely insulated from the conductors within the globe and from all external conductors or bodies.

Wanted to See the Members of the Firm.

An amusing story is told of an elderly Irishman who presented himself at the office of the Hyde Park Thomson-Houston Light company in Chicago the other day in an evident state of excitement. "There do be somethin' the matter with me electric light lamp," he declared, "and I want it fixed at wance." An office attendant assured the irate caller that the trouble would be speedily investigated, but he was not to be pacified. "It's not with the likes of you, young man, that I'm after talking," he exclaimed scornfully. "I'll have nothing to do with subordinates. Show me to Mr. Thomson or to Mr. Houston—wan av thim—and we'll see if I pay me money to thim for the fun of having a dark lanthern hung up in me store." The old gentleman's earnestness was of no avail, however, and he was finally convinced that neither Mr. Thomson nor Mr. Houston was in just at that time, and that he must leave his complaint with others.

Reminiscences of the World's Fair.

By A. Howland.

To those electrical engineers who were so fortunate as to spend a considerable portion of their time at the World's Fair last year the odd sayings and actions of the country people were a never ending source of amusement. Among many others the following incidents may be of interest. They are all strictly true, and are given exactly as noted by actual observation. In one case the scene was a room in the electricity building where meters were the chief exhibit. A small electric fan stood upon a table at the entrance, and a meter standing near by measured the energy consumed by the fan. A couple of women stepped up to the table one afternoon just after the fan had been started. "Say, what is that thing?" asked the first. "O, that is just one of those electrical machines," answered her companion; "just look at the electricity whirling around in there; it goes so fast you can't see it!" "O, no," returned No. 1; "that isn't electricity; that's glass; don't you see how you can see right through it?" "Why, that's so," the other replied, holding her hand in the breeze; "and just see here; you can feel the electricity coming out. Just put your hand there!" "I don't want to," said the first; "I am afraid of those electrical things;" and she pulled her companion away.

It was rather curious to note some of the names applied to the Edison tower of light in the center of the building. One lady wished to know "when the post played," referring to the operation of flashing the tower that occurred at twenty-minute intervals during the evening. Another, "if that pole is going to light again to-night?"

A common question asked by the old farmers was: "I don't want to take but a moment of your time, young man, but I want to ask you just a little question. "Can you tell me how they get electricity out of those dynamos and how they carry it into the cars, and how they make the cars go with it?" I regret to say that after patiently working for an hour or so on a solid explanation, the old fellows were sometimes sent from one man to another among the exhibitors until they must have realized either that the question was not so easy to answer after all, or that someone was having a little fun at their expense. A vast number of needless questions were often fired at the poor exhibitors, who of necessity must answer each politely, although sometimes it must have been rather a hard task. Among many others the following will serve as illustrations:

During an experiment calling for his undivided attention one of the attendants was interrupted by a seedy-looking individual who kept the crowd waiting while he beckoned the young man forward, and, pointing to a large sign fastened to the side of the gallery, read the following in a loud voice, indicating each word with a bony finger: "Do not fail to visit the many interesting exhibits in the gallery." He then asked: "Say, mister, where be the place to go to see them exhibits?" After being politely informed that he would do well to try the gallery, he trudged off with a pleasant "Thank you kindly, sir," while the crowd about the railing smiled audibly.

A very brilliant question asked of one of the exhibitors one day was: "Will you please tell me, sir, what power

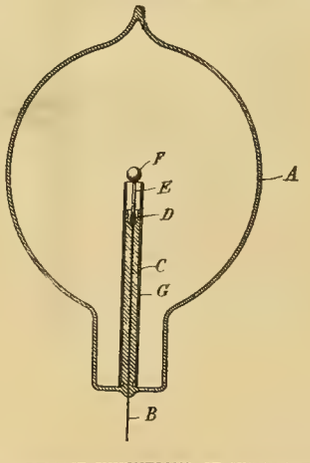


FIG. 4. RECENT INVENTIONS OF NIKOLA TESLA.

engine I must get to run an electrical dynamo to get all the power I want out of it?"

A third and last example will be sufficient. A short and rather stout lady stepped up to one of the engineers in charge of the tower of light and said: "Will you tell me where it is that they hatch chickens by electricity?" After being directed to the easiest way of getting to the proper place, she volunteered a perfect shower of foolish ques

tions, ending with, "Well, what do they hatch chickens by electricity for, anyway?" The young man, who was pretty well exasperated by this time, looked at her for a moment and answered, quietly, "Well, madam, I suppose it's so as to give the old hen a rest and a chance to see the fair!" It is needless to say that she asked no further questions, but went her way in peace.

Carpenter's Secondary Battery.

Hiram H. Carpenter of St. Louis has introduced a secondary battery, in which it is claimed the area of active material is increased without a corresponding increase in he weight of the cell. The special features of this battery are illustrated in the accompanying cuts. Fig. 1 shows a sectional side elevation and an end elevation of a block of active material while Fig. 2 is a transverse sectional ele-

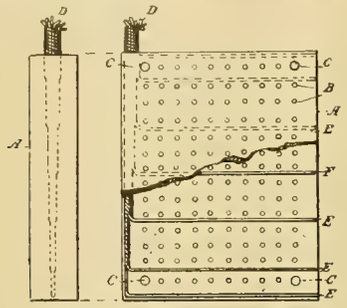
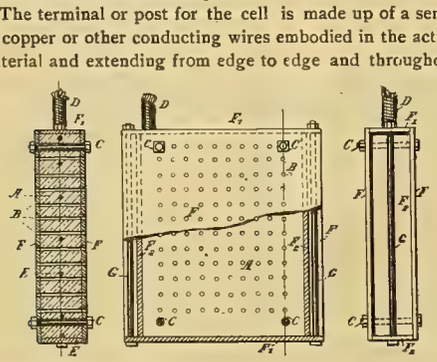


FIG. 1. CARPENTER SECONDARY BATTERY.

vation. Fig. 3 is a sectional side elevation of the block of active material in position in an exterior perforated case or shell, with parts broken away. Fig. 4 is an end elevation of the cell complete and Fig. 5 is a side elevation of the negative electrode.

The positive electrode is composed of a block or body *A* of active material or material to become active, rectangular in contour and provided with numerous horizontal perforations *B* throughout its surface. This body of material is preferably cerusite, although it may be red lead or other lead oxides, or any common active material. The body *A* is also provided with horizontal perforations *C* adjacent to each corner, for the passage of suitable bolts made of insulating material, for the purpose of binding the opposite side plates *F* of insulating material firmly in position upon opposite sides of the block. The insulating sides *F* are preferably composed of ground or pulverized mica mixed with a paint composed of asphalt and other common ingredients having the chemical quality of resisting the action of the electrolytic fluid, and then compressed or solidified in any known manner into the form of plates. These side-plates *F* are also provided with horizontal perforations *B* and *C*, which register with like perforations in the block *A*, so that all of the perforations pass entirely through the element or cell thus made up.

The terminal or post for the cell is made up of a series of copper or other conducting wires embodied in the active material and extending from edge to edge and throughout



FIGS. 2, 3 AND 4. CARPENTER SECONDARY BATTERY.

the body, and having their adjacent ends twisted together in the form of a cable *D*, the upper end of which projects above the upper end of the cell, and the ends of all the wires or strips at that point are soldered together, so as to provide a practically solid post or terminal which may be connected up in the usual manner. It will be observed that the post *D* has the greatest diameter at its upper portion and gradually tapers downward to a point adjacent to its lower end. By reason of the wires or strips *E* being thus distributed throughout the body or block *A*, the resistance of the body is greatly reduced, and the efficiency of the cell, it is claimed, is correspondingly increased, the numerous small perforations *B* also acting to increase the efficiency of the cell by permitting ready access of the electrolytic fluid to numerous closely adjacent portions of the active material. The wires or strips *E* may be composed of copper, lead or any good conducting material suitable for the purpose.

In twisting the wires or strips *E* together to form the terminal *D* it will be noticed that the strips or wires are superposed to form the vertical post or terminal.

F^1 indicates horizontal top and bottom plates, and F^2 the vertical edge plates of the cell which are made of the same insulating material of which the side plates *F* are composed, and securely clamped together and in position by means of vertical bolts *G*, so that the active material is surrounded on all sides by the exterior casing or shell of insulating material.

The negative electrode *I* is composed of a common lead pipe or tube, in which is located, so as to extend from end to end, a wire or strip *H* of copper or any good conducting material, so that one end of the wire or strip projects free beyond the outer end of the pipe or tube, and the opposite end of the wire or strip is sealed within the pipe or tube, by soldering or burning the adjacent end of the pipe or tube. This pipe or tube is entirely devoid of active material, and is in contact therewith from end to end. The free ends of the lead pipe or tube and the wire or strip *H* project upward adjacent to the upper edge of the negative electrode so as to form a terminal or post which may be connected in the usual manner. The pipe or tube is coiled up so as to form what may be termed a flat rectangular coil, as shown in Fig. 5. This method of coiling and forming the negative electrode reduces it to a very compact and convenient form.

COMMUNICATION.

Institute Meetings, Special and Regular.

To the Editor of the WESTERN ELECTRICIAN:

In reading your editorial remarks on my letter in your last issue, I see that I have failed to make myself understood on one or two points. Rule VI. of the Institute, which relates to meetings, reads as follows:

"The annual meeting of the Institute shall take place on the third Tuesday of May, at which a report of the proceedings of the Institute and an abstract of the accounts shall be furnished by the council. Two other regular meetings of the Institute shall be held each year, at such times and places as the council shall select, and notice of the meetings shall be given by mail or otherwise to all members and associates at least twenty days in advance. Special meetings may be called whenever the council sees fit; and the secretary shall call a special meet-

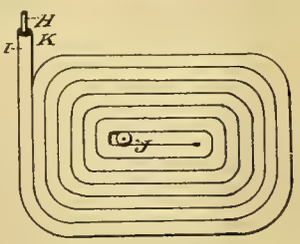


FIG. 5. CARPENTER SECONDARY BATTERY.

ing on a requisition signed by fifteen or more members. The notices for special meetings shall state the business to be transacted, and no other shall be entertained. Every question which shall come before any meeting of the Institute shall be decided, unless otherwise provided by these rules, by the votes of a majority of the members then present. Any member or associate may introduce a stranger to any meeting, but the latter shall not take part in the proceedings without the consent of the meeting."

You are, of course, correct in saying that 40 or 50 members at a special meeting have no right to legislate for the 700 who do not attend, and I had no intention of intimating that they had such a right. The fact that we have already transgressed in this respect is no excuse for continuing the practice. On the other hand, even at the regular meetings, whenever or wherever held, we can never hope to have present more than a fraction of the total membership, so that distant members who cannot attend will have to content themselves with written communications to be read by the secretary.

TOWNSEND WOLCOTT.

New York, February 6, 1894.

African Telegraph Lines.

The Congo state has decided to construct a telegraph line fifteen hundred miles up the Congo river to Kasongo and then two hundred and fifty miles east to Lake Tanganyika. It is not at all likely that so great an undertaking will be carried out very rapidly, says the New York *Sun*, but it is a sign of the times that the authorities of the Congo state have voted to build the line to its eastern boundary on the lake that has the distinction of being the longest lake in the world. The line is now building at its western end, along the track of the Congo railroad.

Perhaps ten years will elapse before the telegraph station is built on the borders of the great lake. By that time the Germans and the British will have carried out their plan to join the east coast by wire with Tanganyika and Victoria Nyanza. In a moment news will be flashed across the continent, along the very routes which the pioneers of discovery used to follow for two or three years before they could come again into touch with civilization.

There is nothing visionary, to-day, about such schemes as these. Twelve years ago Stanley's idea of a telegraph line to Uganda was condemned as chimerical, but to-day a hard-headed capitalist like Cecil Rhodes pins his faith to the practicability of an inland telegraph line from South Africa to Cairo. The wire already stretches from Cape Town four fifths of the way to the Zambesi. From the delta of that river messages are flashed more than half the way to Lake Nyassa. No obstacle has yet appeared that cannot be overcome. There are and will be unfavorable prognostications. When our own first transcontinental line was strung there were people who, with the eye of prophecy, saw Indians cutting the wire and buffaloes playing the mischief by using the poles as rubbing posts. But the Indians and the buffaloes were merely bugaboos.

The development of the telegraph service in Africa will come gradually, and it will be of immense advantage to the various enterprises there. Egypt, among the civilized lands, bids fare to profit most; for the day is surely coming

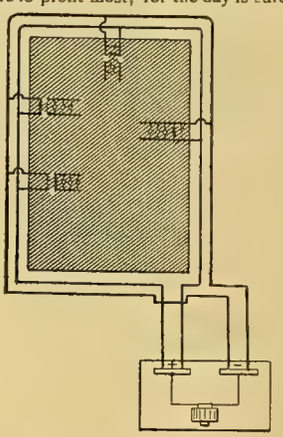


FIG. 3. ELECTRIC LIGHTING IN LONDON.

when she will be notified many weeks in advance of the amount of the Nile floods that are on the way, and these statistics and warnings will be of the greatest practical value to the densely populated lower valley of the Nile.

Electric Lighting in London.

One of the most important factors in the electric lighting of London is the Metropolitan Electric Supply company. This corporation, established in June, 1888, was augmented later by the absorption of the Whitehall Electric Supply company, a consolidation of interests which has made the Metropolitan company one of the most extensive and successful in England. Without going into details concerning the territory conceded to this company, it may be stated that it is the most important in London, as well as the most extensive, with the exception of that section controlled by the London Electric Supply corporation. The stations, six in number, are located within the limits of the City. These stations were equipped as rapidly as possible and the extension of the service was pushed at a proportionate rate of speed. The number of lamps in service at the present time is in the neighborhood of 157 000. The station at Whitehall court, originally operated by the Whitehall Electric Supply company,

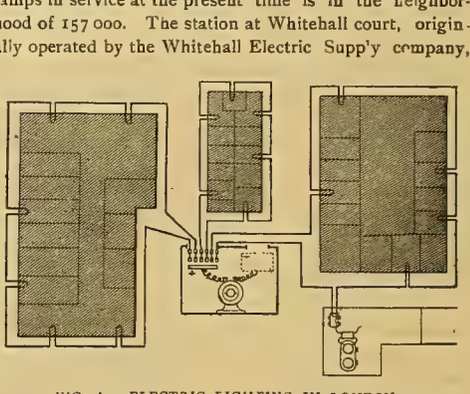


FIG. 4. ELECTRIC LIGHTING IN LONDON.

differs materially from the other stations. It was designed to supply a low tension, direct current system, which was distributed on very short circuits by means of feeders, regulated by batteries of accumulators. The general type of stations controlled by this company is best illustrated, however, by reference to the illstallation on Sardinia street, which has a total capacity of 25,000 lights. In Fig. 1 is shown a view of the dynamo room, including the switchboard.

A sectional view of the entire plant is presented in Fig. 2, illustrating the manner of belt driving employed. The engines are located in the room below the dynamos. The belting and pulleys in the dynamo room are protected by hoods which also serve as oil splashers. An electric traveling crane is in place in the dynamo room and is used for lifting dynamo armatures and other heavy machinery. Heavy I beams furnish a solid foundation for the electrical machinery.

The Westinghouse system, employing an alternating current of 1,000 to 1,500 volts, was adopted for this station. The two-wire system with house transformers is used in accordance with the following plan: All the dynamos in the station are connected in parallel. The district which is furnished with light by this station is divided into a number of groups and blocks of buildings, which are encompassed with two circuits according to the plan in Fig. 3. This system is looked upon in England as praiseworthy. As both ends of each cable are connected with the same bar on the switchboard, one of these cables may be cut at any point without depriving the transformers of the current passing through them, for the entire current would pass through the unimpaired leg. This system of distribution may also be accomplished with one cable by connecting a pole of a dynamo to earth, as well as one end of the primary transformer circuit as illustrated in Fig. 4. Although the apparatus is always placed out of the reach of the public, the system is not without danger, and the Board of Trade will not allow such an installation. At each point where a transformer has been installed, a switch and a safety fuse have been placed. Each subscriber, when he wishes to turn on his light is obliged to throw his switch on the main circuit. In installations where losses to earth or leakage occur this idea is considered of merit because it limits the attendant leakage to the duration of the light. In addition the presence of a safety fuse on a primary is a safeguard against an excess of loss or a short circuit on the secondary.

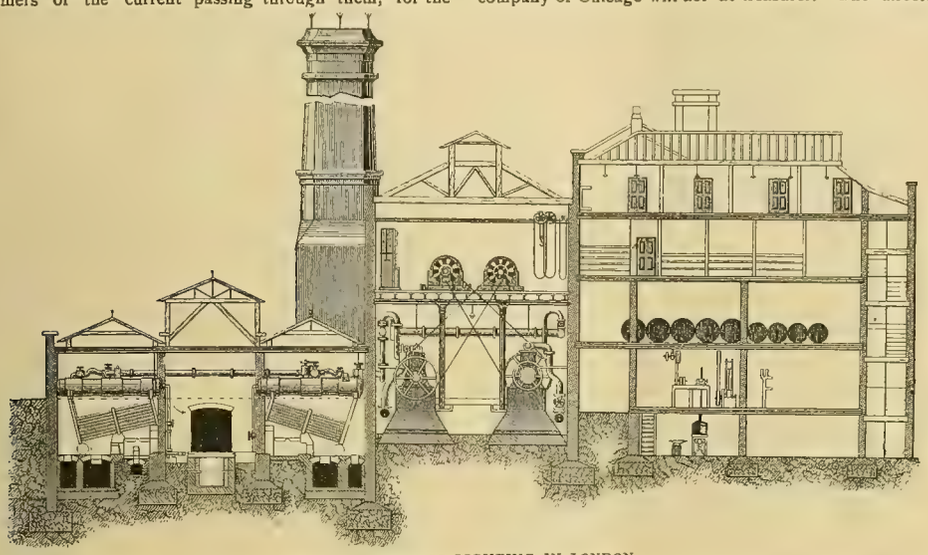


FIG. 2. ELECTRIC LIGHTING IN LONDON.

The station itself is located in the region of Saint-John-in-the-Fields and furnishes current principally for that portion of the city comprised between Holborn street and the Strand. No better idea of the arrangement and convenience of the plant could be had than by reference to Fig. 2. Offices are located in the building, rooms for storing cable, a practical workshop, a forge, and all the appliances which are necessary in an emergency are kept at hand. Much care was taken in constructing the plant to insure a good supply of water and the yard around the building was dug to a depth of 12 to 15 feet to provide accommodation for 400 or 500 tons of coal at one time. The steam power is furnished by a dozen Babcock & Wilcox boilers, separated into two batteries of seven and five. The boilers are of 210 horse power capacity each and are supplied with water by Worthington pumps. Between the batteries of boilers, which front each other, runs a coal railway, so that fuel is brought as needed from the yard to the boilers in small hand cars. The Sunbeam lamp is used almost entirely upon this system. The plant is said to run admirably and it may be taken in most of its features as a type of the Metropolitan company's central station. The foregoing description is summarized from an article in *L' Electricien*.

A New Disease.

It is stated by the *Commercial Gazette* of Cincinnati that fifty per cent. of the motormen on the newly opened electric lines of that city are afflicted with a new malady known as the "trolley foot." The alarm gongs, operated by the pressure of the motorman's right foot on a button in the floor of the car platform, are said to be responsible for this state of affairs. The exertion brings new muscles into play, and after the first two or three days on the new cars many of the motormen were so afflicted with stiffness and soreness in the right foot and ankle that when they came to leave the cars at the end of the route they found some difficulty in walking. The malady was promptly dubbed the "trolley foot" by the other employes, although it is difficult to see any connection between it and the trolley, and promises to become epidemic when the electric lines are extended all over the city. Of course the soreness soon wears off, as the muscles of the foot and ankle become inured to the strain upon them.

The Telephone Situation.

At a meeting of the Harrison International Telephone company held in Chicago recently S. B. Elkins, late secretary of war, was elected president; C. M. Ferree of Kansas City, vice-president, and Patrick Egan, late United States minister to Chile, secretary. The Northern Trust company of Chicago will act as treasurer. The directors are: F. M. Holden, Kansas City; George R. Peck, general solicitor of the Santa Fe railroad; Major W. Warner, Kansas City; Dr. E. M. Harrison, the inventor of the device, Fort Smith, Ark.; Stephen B. Elkins, West Virginia; R. C. Kerens, St. Louis; A. L. Stone and E. L. Ingles of Chicago. The policy of the company, which will be vigorously pursued, it is said, was outlined and determined upon at the recent meeting in Chicago, where the headquarters of the company are. State organizations are to be formed everywhere, and through them auxiliary organizations, by cities, towns and communities. The latter will rent the telephones from the parent company and will in turn rent them out to subscribers. It is asserted that the rental to the auxiliary companies will be $7 per year, and that the rate to subscribers should only in exceptional instances be double this figure.

A Wall street firm of stock brokers—Dow, Jones & Co.—has this to say of the relations of the Western Union and Bell companies: "It may be that the Bell Telephone company intends to use its long-distance wires for the purpose of doing a telegraph business. It is certain that long-distance telephoning has not proved a profitable experiment. The first cost of the long-distance plant has been very heavy, making necessary a charge for conversation so high as to be almost prohibitive at points a considerable distance apart. When people have called a correspondent on the long-distance telephone, the caller has not been willing to pay unless the person wanted was found; consequently the company has been obliged to try to find him, and, in a large proportion of cases, has not been able to do so, thereby entailing trouble and expense without remuneration. Long-distance telephoning has proved a success when applied to districts closely connected. It may be that the intention is to adopt some system like sending messages by telegraph over the long distance wires and then repeating the message by telephone to the point desired, thereby doing away with the cost of delivery, which forms a considerable item in ordinary telegraphing."

It is stated that a large additional block of stock in the Duluth, Minn., Telephone company has been purchased by Chicago representatives of the Bell interest.

A Boston dispatch contains this statement: "Notwithstanding the expiration of the Bell Telephone patents, the United States government is still taking testimony, as it has been for four years past, to annul the Bell patent, on the claim that Drawbaugh and not Alexander Graham Bell was the original inventor of the telephone. It is calculated that two years more must be consumed in taking testimony by the United States officers presenting this claim against the American Bell Telephone company. None of this evidence has yet been printed, and it is estimated that it will cost $15,000 to print what has thus far been taken."

An Exciting Run.

An intoxicated motorman caused considerable damage during a two-mile run of his car at Orange, N. J., January 26th. When a car belonging to the Consolidated Traction company reached Roseville from Newark, on its way to Orange, the motormen were changed. The man who took charge of the car was intoxicated. Before going half a mile his car struck the rear end of an express wagon. The rear of the wagon was crushed and the driver thrown out. The driver was uninjured and regained his seat. At Brick Church, about a mile and a quarter beyond, the car again overtook the same wagon and again ran into the rear of it. The blow was not hard enough to throw the man out, but it did more damage to the wagon. A few yards farther on the car hit a loaded coal wagon. A block further up the street the car hit a butcher wagon. The frightened passengers tried to get off, but the motorman would neither stop the car nor would he allow the conductor to do so. There was great excitement among them for a time. Finally the conductor pulled the trolley from the wire and caused the car to stop. The conductor refused to allow the trolley to spring back until a second car ran up. Then he transferred his passengers to the second car and started his own car. The passengers who wished get on were told to take the rear car and the conductor obliged the motorman to run to the stables.

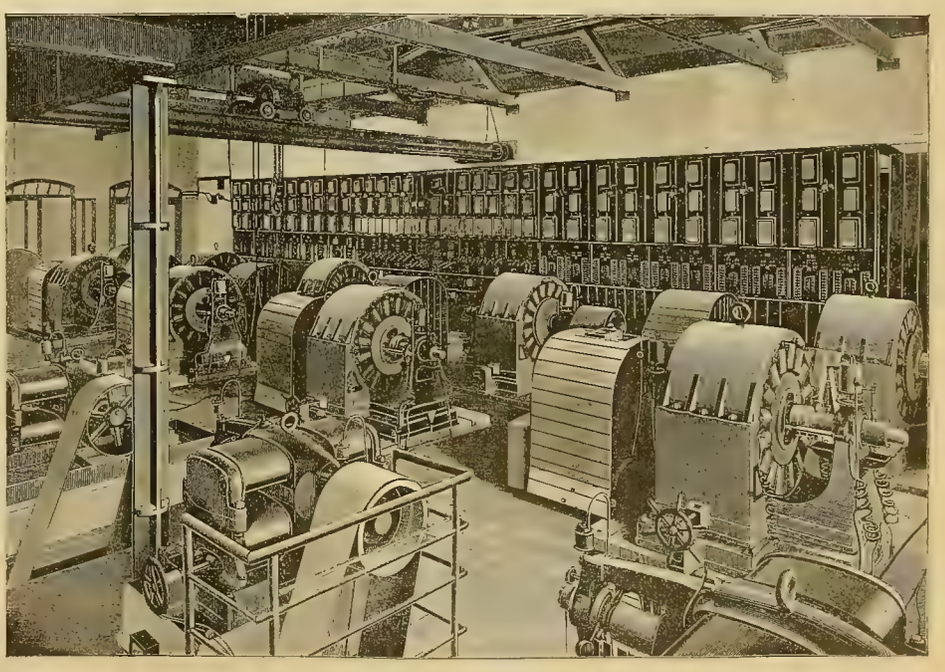


FIG. 1. ELECTRIC LIGHTING IN LONDON.

It is interesting to note that, according to the analysis of the causes of 44,141 fires in the United States in 1892, published by *Rough Notes*, the percentage of the whole number of fires attributed to electric wires and lights was only .37 per cent., and the per cent. of the whole amount of loss from the same source 1.37 per cent., while to lamp accidents, candles, gas jets and the careless use of matches is assigned 6.32 per cent. of the total number of fires, and 2.63 per cent. of the total amount of loss.

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WE have tried advertising in several electrical papers, and after discontinuing our advertisement in your journal [*Electrical World*] we advertised for a considerable period in the WESTERN ELECTRICIAN, which we found a valuable paper for reaching the West, our card in that paper bringing us many communications, a number of which resulted in sales of our alternating apparatus, including a plant for the University of Wisconsin.—*Extract from a letter of F. A. La Roche, president of the La Roche Electric Works, Philadelphia, to W. J. Johnston, publisher of the Electrical World.*

ANNOUNCEMENT is made of the application of a syndicate composed of American and Mexican capitalists for a concession from the Mexican government for the building of a telegraph line through that country. The plans of the syndicate contemplate the construction of a Pan-American telegraph line to extend along the Pacific coast from Victoria, B. C., to Santiago, Chile, passing through the United States, Mexico, the Central American States and the Pacific coast countries of South America. Such a line would be of great international importance, and would undoubtedly facilitate trade between the countries through which it passes.

THE legislators of New York state have not yet finished "regulating" the affairs of the street railway companies operating in that state. Senator Owens of Brooklyn has introduced a bill compelling companies operating trolley cars to place two extra men at the front of each car to look out for persons on the track or obstructions. An addition to the platforms of the cars would be necessary to accommodate these men. The bill is regarded as a "strike," and is denounced by decent members of both houses.

MANY of the cities of Massachusetts that have electric railway systems are considering a proposition to extend their lines and form a network connecting the principal points and affording means of quick and cheap transportation. A company has been formed to exploit the project. A similar project has been advocated in other states, especially in New Jersey. In many parts of the country neighboring cities have been connected by trolley lines, and there seems nothing visionary about the proposition to establish a network of electric railways throughout the thickly populated state of Massachusetts.

MR. PREECE'S record of his observations in the United States last year, a portion of which is published in this issue, is well worth reading. The position of the author as chief electrician of the British government telegraphs has made him for many years a conspicuous figure in English electrical circles and he is also well known in this country, where he has many friends. Mr. Preece possesses a genial, sociable disposition, and he is sometimes accused in England of being all things to all men. However, in his account of his latest visit to this country he has not attempted to gloss over what he considers our electrical faults, while finding much to admire. As Mr. Preece has devoted a life-long study to telegraphy his comments on American practice in this department are of particular value and deserve careful consideration. It is a noteworthy fact that although Mr. Preece is not blind to the defects of the existing commercial systems, he does not believe that the government control would be of advantage. Indeed, he goes so far as to express the opinion that it would be at present "absolutely impossible," owing to the unsettled condition of the civil service. His remarks on this subject are so pertinent that we cannot refrain from introducing the following quotation here:

> A business like that of telephones or telegraphs can only be conducted properly by those who possess a considerable amount of enterprise, and who look primarily to the necessities of the community. The reason why our postoffices and our telegraph offices at home work so well is because the public exercises such a useful and such a determined supervision over the work. The free opening of the press to complaints; the criticism to which the public service is subjected; the readiness with which members of the House of Commons ask questions—though at times, perhaps, irritating and vexatious—are undoubtedly good for the service, for they keep us all alive. Such a state of affairs is impossible in the States. The government of the United States must first reform its civil service, and when it gets officials into the service whose tenure of office is secure and whose zeal is as unquestioned as it is in England then there will be some chance of their government acquiring the telegraphs; but under existing circumstances the acquisition of the telegraphs by the government of the United States would amount virtually to the deterioration of the service.

This is but too true, we fear, and should afford food for reflection to the ever-present congressional advocate of government control.

THE latest claimant for electric railway notoriety is a syndicate, which, it is said, has practically secured franchises for the construction of an electric railway between New York and Philadelphia. Many syndicates have "projected" roads of similar character, not only between these two eastern cities but between New York and Chicago and one proposed electric road has for its object the crossing of the Rockies. According to report the Philadelphia-New York scheme has been in contemplation for a long time and capitalists have been quietly securing franchises along different portions of the proposed route. It is intended to parallel the Pennsylvania Railroad company's line between the two eastern cities and touch all the important cities and towns upon the way. Rumors as to the details of this gigantic scheme and the identity of its promoters have been many, but it is a difficult matter at present to discriminate between facts which have been made public and the suppositions which are sure to follow accompany an undertaking of this character. Whatever may be the outcome of the present agitation there is no doubt that the field for short electric systems is being rapidly and profitably filled and that private capital, seeking investment in transportation enterprises, will eventually be attracted to the construction and operation of electric railways for long distances. With the field once opened its possibilities will be recognized; improved apparatus will be manufactured to meet the exigency of the demand and networks of electric lines connecting the great centers of business, it is not too much to prophecy, will eventually develop.

There is doubtless truth in the statement that the Canadian Pacific Railroad company intends to experiment with electric traction in crossing the Rocky mountains. If the statement be indeed true, it is a subject which will receive careful attention. Practically under government control, the railroad company will have every encouragement to be exhaustive in its trials. But should the outcome of these two projects, one in the East and one in the West, fail in ultimate realization there is no reason for discouragement. The field for long-distance electric railway lines is practically unoccupied. Thought and energy have at least been turned to it, and the outcome if successful will be a guide.

THE severe storm which visited Chicago last Monday worked havoc with overhead electric wires, yet the damage was not as great as might have been expected. According to the daily papers, and it must be admitted that they are not friendly critics, the trains on the cross town electric lines were kept going much more regularly than the cable and horse cars. This must have been a great surprise to the people who had been led to believe that the trolley system was inferior to the cable in such weather. Monday's storm demonstrated most conclusively that the trolley system was by far the most efficient method of street railway propulsion that has yet been discovered. It should be borne in mind, too, that these cross-town lines are operated by the South Side cable company and are merely feeders for the State and Cottage Grove avenue cable lines, and necessarily of only secondary importance to the company. Of course the management devoted its main efforts to keeping the cable routes which traverse the business center open, yet with far less attention the service on the trolley lines was vastly superior.

Telegraph and telephone companies were badly crippled by the storm. In the city, where the wires are underground, scarcely any trouble was experienced. But in the suburbs and in the country many gangs of men were employed repairing the damage. At the main office of the Chicago Telephone company more than 1,000 complaints were noted. These came in the main from the outlying district and the trouble was caused generally by the crossing of telephone wires. Everything considered, however, the service was admirable. Between 8 o'clock Monday morning and 5:30 o'clock the same evening sixty thousand calls were answered by the Chicago exchanges. In the residence districts public telephones were in use all day. Business men who were unable or unwilling to go to the city on account of the storm, communicated with their offices by telephone and in many places there were lines of men waiting an opportunity to talk with their clerks or representatives down town. It is safe to say that more business was transacted by telephone in Chicago on Monday than ever before in a single day, and this, too, in spite of the fact that it was a legal holiday. As usual, the long-distance service was everything that could be desired. New York and Milwaukee and all other points within reach of Chicago by this system, found no difficulty whatever in carrying on conversation, and the lines were well patronized.

The Western Union Telegraph company had every lineman in the vicinity of Chicago at work. Wires were down everywhere and there was no direction from which reports of damage did not come. Some of the smaller towns were without direct telegraph connection for several hours, and the whole service was badly crippled. In some instances the company had much difficulty in delivering messages. Service with New York and the larger cities was in the main satisfactory, although in some cases a very round-about circuit was used. The Postal company apparently had less trouble, but their service was not entirely free from vexatious delays.

The lesson of the storm is one that has been impressed upon electric companies at regular intervals for many years, yet they do not seem to give it sufficient attention. From a financial view point it would seem to the interest of the telegraph and the telephone companies to raise the standard of their line construction. True, there has been marked improvement in the last ten years, but there is still much to be done before the service is brought to the point where it may be depended upon during severe tests like the storm of last Monday.

Notes of a Trip to the United States and to Chicago, 1893.[1]

By W. H. Preece.

Part I.

In 1877, together with H. C. Fischer, I made an official and thorough inspection of the telegraphic system of the United States and Canada, and the lessons of that journey were reported to this Institution on February 13, 1878. The results of that trip were the introduction of the telephone, the practical application of quadruplex working, the adoption of sound reading in our telegraph offices, the disappearance of the Morse recorder, and the more general assimilation of the methods of working in the two countries.

In 1884, as a member of the British Association, I again visited Canada, and made another tour through the States, reporting my observations to the Institution on December 11, 1884. The chief result of this second trip was the introduction of the multiplex system of working of Mr. Delaney, now so much in use among us, and doing splendid service with many of our chief towns; hexode working, six messages in any direction being simultaneously transmitted between London, Brighton, Bristol, Birmingham, and other commercial centers. The telephone was found fully developed, and firmly rooted as an invaluable aid in domestic and business requirements. The electric light was making great advances, especially as the illuminant of public streets and ways, to the great advantage and safety of the public, but electric railways and the transmission of power were only just looming in the air in an extremely tentative and experimental stage.

Now I am able to report another tale of a ten weeks' trip taken in August and September last over much the same ground, but with two *pieces de resistance* thrown in —a visit to the great "World's Fair" and the holding of an electrical congress at Chicago.

TELEGRAPHS.

The telegraphic system in the United States is in the hands of two great private telegraph companies, the Western Union Telegraph company and the Postal Telegraph company.

The Western Union Telegraph company, which is by far the larger of the two, is a gigantic undertaking. It is a congeries of at least 500 other companies which have been purchased, absorbed or amalgamated from time to time; and it is also closely connected with virtually all the railways in the States. This connection with the railway companies gives it a very prominent and commanding position over its rival. In order to show the progress made since 1884 and the present condition of the business, I give the following table.

Particulars.	1884.	1893.	Great Britain, 1892.
Miles of poles and cables	145,037	189,936	33,689
Miles of wire	450,571	760,201	207,231
Offices	13,761	21,078	8,537
Messages	42,076,226	66,591,858	72,304,559
Capital	$ 80,000,000	$123,000,000	£ 10 130 820
Receipts	10,632,040	24 978,442	2,486 791
Expenses	13,027,504	17,482,405	2,470,839

The Postal Telegraph company is a very much smaller concern. It has virtually come into existence since my previous visit, for when I was last in the States it had just commenced its operations, and it only possessed 1,500 miles of line and 4,260 miles of wires. It is a company which has been promoted, not so much to attack the Western Union company, as was the case with all previous competing lines, but to establish a collecting company for the cable business, which is in the hands of the Commercial Cable company. The present position of the Postal Telegraph company is as follows:

Miles of line	15,997
Miles of wire	99,664
Offices	2,664[2]
Messages	9 335,291

The enterprise in telegraph work is evident at once on landing in New York. Every passenger on landing at the dock stage is approached by a messenger from one or both companies, soliciting messages; and on all the stages, except that of the Cunard company, one or other of the telegraph companies has succeeded in establishing an office. The business done at these offices is very great, as when facilities are thus given to passengers to send messages, nearly every one wires home his or her safe arrival. This enterprise is evident everywhere. The blue and white sign of the Western Union company, which is extremely prominent, is found in every hotel, at all railway stations, and in large cities, and is as abundant as the post-office sign is in England. At Long Branch, the Brighton of New York, where I spent two or three very pleasant days, there were no less than 19 offices belonging to the Western Union company, and all paying.

There were 20 offices in the World's Fair alone, and 70 hotels in Chicago have Western Union offices in them.

Competition is intense, but there is no war of rates. A general tariff has been agreed upon, and the only rivalry that exists is in the collection and transaction of business. Dividend-earning being the chief end aimed at, only paying commercial stations are properly served. Social and domestic telegraphy is practically ignored, and sparsely populated districts are very inadequately provided for. Hence in the United States telegraph business is neither so general nor so cheap as it is with us. The average price received per message is 15¾d., as against 7.7d. earned by us. On the other hand, however, it must be remembered that their mean distance is far in excess of ours.

CONSTRUCTION OF LINES.

I inspected considerable lengths of the line work constructed by each company, and drove over many miles of a new road line passing through Connecticut.

In this direction American electrical engineers have been very much behind us. They have not built their lines so solidly, nor have they followed true engineering principles in the same way that we have.

As a rule, their old lines are extremely irregular, being badly constructed with poles that we in England would not look at. But recently, owing to the difficulty in finding fresh routes, the growth of the number of the wires, and to the absolute necessity for accuracy of workmanship for securing silence on telephone lines, great improvements have been made and some of the trunk lines put up by the telephone companies, and the new trunk line put up by the Postal Telegraph company will compare very favorably with our best modes of construction.

The telephone line to which I have alluded consists of 16 arms, each carrying 10 wires, or 160 wires in all; the poles are 60 feet high, and are placed 100 feet apart. The arms are of pine, and their scantling is 3¼ inches by 4½ inches, and they are 10 feet long. Owing to the use of wooden pins they are bored with holes 1½ inches in diameter. This weakens the arm, and I observed two instances where arms were broken. A 6 foot arm bored for four insulators costs 15 cents, which is very cheap compared with the price we pay. But they are undoubtedly weak, and not to be compared with the oak arms that we use.

As a rule, the poles number 40 to the mile. They are generally of cedar, but sometimes of chestnut. The cedar poles come from Canada and Michigan. Each 25 foot cedar pole costs $2 25, and is said to last 15 years without preparation. The chestnut pole is a little cheaper, and it lasts only 10 years. It is extremely irregular in shape.

American engineers do not adopt the same plan that we adopt in the erection of arms. They are fixed any way, but generally on the modern lines they alternate on each side of the pole. This is done under the impression that it adds strength to the line. I do not know why it should. (We invariably fix the arms on that side of the pole facing London.) Every fifth pole is earthed as a protection against lightning. (We earthwire every pole.) Stays are very little used indeed, but on new lines they have longitudinal stays in the direction of the wires, one end being fixed at the foot of one pole, and the other end at the top of the next pole. These are called "head guys," and are frequent. Iron poles are used only for electric railways. These are very substantial, and look very well. They are made in three sections of simple iron tubes, either 6, 5 and 4, or 5, 4 and 3 inches in diameter respectively.

Pole roofs are not used as with us, but the poles are tapered off to throw off the rain.

Neither the Western Union nor the Postal Telegraph company adopts any system for preparing its timber to resist decay. My attention had been called to a system of artificial seasoning called "wood vulcanizing," and it was reported that this system had been adopted by the Western Union company. I found this was not true. The Western Union company had experimentally tried the system on some wooden troughing, employed for the protection of their pneumatic tubes underground; but the process was so expensive and the advantages so doubtful, that they do not apply it to their poles or their arms.

Copper wire is very much used on telegraph and telephone lines. I saw in the exhibition at Chicago a form of wire called "tempered copper." This is said to be extremely strong and hard, but it is evidently an alloy of copper, for its resistance is high. I was surprised to find that a compound wire 1.7 ohms resistance per mile, put up by the Postal Telegraph company in 1883, is still in use, and working well. Our experience of the durability of this wire was disastrous.

UNDERGROUND WORK.

Underground work was scarcely started in the States in 1884, but now, owing to peremptory legislation on the part of the municipalities, it has made very rapid progress. Underground work in the cities of the States has become general, with great advantage to the public, and also, as they have come to acknowledge, to the companies themselves. The only exception to this rule that I heard of was at Boston, where complaint was made that their underground system had been much disturbed by "wash outs." These "wash-outs" are freshets or great floods tearing up the line and carrying away the pipes and wires.

The system of underground work adopted by the telegraph companies in America does not differ much from that adopted by us, excepting that they do not use gutta-percha, owing to its high price. They are using very largely a cable similar to the Fowler-Waring cables, and also kerite-covered wire. Kerite is a form of vulcanized india-rubber.

OFFICES.

Not much change has been effected in the mode of fitting up offices. Glass of the best quality is used very much indeed; doors, partitions, boxes for the collection of messages, are all made of thick glass. This looks very clean and nice, and is certainly effective.

There is an extremely efficient mode of collecting and distributing messages in the Western Union offices at New York and Chicago. Endless cords are kept in motion by means of small electric motors, and these cords transport small metal carriers somewhat similar to those we use in our pneumatic tubes. Before leaving New York I saw an improvement on this by which messages can be picked up as by the finger and thumb from the desk in front of each operator. They also have in use a system by which messages, envelopes, slips, etc., are conveyed by broad continuous leather belts, 8 inches wide, kept in rapid motion by motors, and upon which the messages, etc., are laid, and carried to the point desired.

Each company has adopted a uniform and pretty looking box for its office in the hotels. American hotels differ from ours in this. The hall of a hotel is usually open to the public, and no hotel that I entered was unfurnished with a telegraph office. I have mentioned that there were 70 hotel offices in Chicago. In fact, hotel proprietors court the presence of a telegraph office. Space is usually accorded free, and board is also provided for the operator. In some places, like the Palmer House at Chicago, which is a great business center, a very high rent is demanded; but, generally speaking, no rent at all is paid. At the hotel I staid at in Chicago—the Lexington—each company had an office in the hall; the rivalry that exists between the two companies taking the form of each striving to work with the louder sounder. The louder was that of the Postal Telegraph company, and when I asked the operator why he allowed his instrument to make such a row, he replied, "We must beat the Western Union company anyhow."

At Fort Sheridan, a military station about 20 miles away from Chicago, the Western Union company opened an office, although the place contained only 1,000 soldiers. The office was worked by the soldiers, and I was assured by the company that they found it to pay well.

The common system in the States is to tile the floors of their telegraph galleries, and not to board them. Fire-proof channels, or conduits fitted with slate tops, are aaranged about the office for the distribution of the wires. Lockers for coats and hats are roomy and well made, and ample in the supply. At Chicago they are of open iron-work, very neatly made, 6 feet 6 inches high, and 28 inches by 8 inches in sectional area. Four men, each of whom is supplied with a key, use such a locker. Great advantage is said to arise from the use of these open lockers in wet weather, and they are worth our own consideration. The use of bicycles for messengers is very prevalent in the States.

Batteries at all the principal offices in the United States are gradually disappearing. The current for working the circuits is being supplied from dynamos or from the electric lighting mains. In New York from 30,000 to 40,000 cells have been replaced by dynamos. At Boston 10,000 cells, which cost probably $20,000 per annum to maintain, have been replaced by current derived from the electric light mains at a cost of $3,000 a year. It must be remembered that the American telegraph circuits are worked entirely on the closed circuit system. They use immense cells, and their cost of maintenance is excessive. We cannot compare their system with ours in this respect, for we use open circuits; and the maintenance of our batteries is certainly, cell for cell, not more than one-fourth or one-fifth that of the United States form of battery.

In New York the Western Union company has a special plant of 51 small dynamos. In Chicago it has 46. The Postal Telegraph company in New York is also using dynamos, and in its new station which is being built it is supplying what it believes to be an improvement on the system adopted by the Western Union company.

We have shown in England that the use of dynamos, owing to the variation of current, is not suitable for high speed working, and I much prefer the plan that we have adopted with so much success in working our Continental circuits—namely, the use of accumulators. Accumulators have an immense advantage over dynamos; they store up energy, so that in the event of any accident or breakdown of machinery the accumulator maintains the circuits working. The accumulator is not in motion. There is no machinery to fail or break. There is nothing to stop and little to get out of order. But the chief advantage of the accumulator is the absolute steadiness of its voltage. There is also economy in capital expenditure, and I am quite convinced that the Western Union company in New York would have effected considerable economy if it had used accumulators charged by the electric lighting plant, instead of supplying the elaborate series of engines and dynamos now working its circuits direct.

At Boston and other stations a very well made and well designed motor-dynamo is supplied by Messrs. Crocker and Wheeler. They are primarily motors worked on the 110 volt electric lighting service, driving a small dynamo, and they transform this down to a voltage which will charge any number of cells required. This system is in use by all the telephone companies, and, as I will point out when speaking of telephones, the service is much improved by the use of accumulators thus charged.

APPARATUS.

I observed little or no progress in the form of apparatus used. In neither company has there been any advance made on the systems in use in 1884. Duplex and quadruplex working are principally relied upon, while on the long-distance lines Wheatstone working is gaining ground, and being much more used. The only novel mode of working that was brought to my attention was a system of working cables automatically. This system has been threshed out by Mr. Wilmot at Waterville, and adopted by the Commercial Cable company, but it has been very much improved upon by Mr. Delaney, the inventor of our multiplex system.

Typewriters have become quite common. The rule is for an operator to have his own machine. The Postal Telegraph company uses this system more than the Western Union company. The latter company employs it invariably for its Wheatstone and other news circuits, but the Postal Telegraph company use it very largely on all circuits; and I watched many operators taking off messages by ear and typeprinting them at the same time, and in all cases the typewriting machine held the sounder well in hand as regards speed.

The working of the Wheatstone system between New York and Chicago is admirable. The grand total of messages handled in one day on this circuit is certainly astonishing—4,211 messages have been passed between these two places on one circuit in a day, a number that we can scarcely hope to rival.

The reason for this is not the greater speed at which the apparatus is worked—for the speed is less than ours—

1. Read before the Insuitution of Electrical Engineers, London, January 25, 1894.

2. Of this number, 860, or nearly one-third, are situated out of the States, in Canada and elsewhere.

but to the fact that the business day in the United States extends over a much greater number of hours than with us. The business day in New York commences three hours before that in San Francisco, and the business day in San Francisco extends for three hours beyond the business day in New York. Hence the business day, which in England scarcely extends telegraphically to four hours, in the United States extends probably to 12 hours. Thus the number of messages handled is much greater per day than with us.

The advantage of Wheatstone working to the company was illustrated while I was there. On August 29th a cyclone in the eastern part of the States prostrated the poles and wires for miles throughout half a dozen states. Three Wheatstone circuits were maintained working—and working badly—between Chicago and New York by means of repeaters at Buffalo and Pittsburg, but on these three circuits 8,693 messages were handled. This was the only means of telegraphic communication between the eastern and western states. Curiously enough, the new and strong long-distance telephone line was not broken down.

On August 18th, while I was there, I took down as having been sent between 8 A. M. and 5:30 P. M.—forwarded, 1,272; received, 1,889. This work was handled on two circuits, with an average speed of 190 words per minute.

The Wheatstone system in the States is much more extensive in the West than in the East. It is giving such good service that it will probably receive cosiderable additions this year.

It must be remembered that between Chicago and San Francisco we are dealing with a distance of 2,500 miles, and on this circuit they were working when I was there at the rate of 110 words per minute.

I observed a very high rate of working on some of the quadruplex circuits. I took down these figures at Boston—forwarded, 686; received, 521. This was an ordinary day's work. On another circuit, between 8:30 A. M. and 11:30 A. M., in Buffalo, the numbers were—forwarded, 126; received, 140, on one side of the quadruplex only.

I noticed at the Chicago exhibition, in the French exhibit, a new adaptation of multiplex working by Mons. Mercadier, who showed in operation 12 working sides. But the working, although interesting, was poor. The reading was done by telephone, and each branch was selected by the sounding of a particular note. The apparatus is not yet in anything approaching a practical stage, but for short lines something may some day come out of it.

PNEUMATIC TUBES.

The Western Union company has not extended its system of pneumatic tubes greatly since my last visit. The Postal Telegraph company is about to use pneumatic tubes for the distribution of its internal work in its new building on a plan somewhat similar to that which we use at our central station.

The only novelty in pneumatic tubes that I saw was that on trial between the postoffice at Philadelphia and a sub-office in Chestnut street. This is a line of two pipes 6½ inches in diameter and 5,792 feet in total length—that is, a distance between the two offices of 2,896 feet. The carriers are metal cylinders whose inside dimensions are 16 inches long, and 5½ inches in diameter. They weigh 6 pounds each, and carry 120 letters. The carrying capacity of the line is said to be 180,000 letters per hour, but I think this is exaggerated; the time taken by a carrier in transit is 55 seconds, and the air pressure is maintained at 7 pounds per square inch.

The line has been working since February 17th, and it has been used for the transmission of letters, the whole service to this particular sub-office being done through the pipe.

The pipe is continuous, and a current of air is constantly flowing through it. Twenty-five horse power is absorbed in maintaining this current at the pressure required, and the carriers are said to move at the rate of 40 miles an hour. Twenty five carriers are in use.

Unfortunately, while I was there the tube was out of use, for the boilers had broken down. These boilers belong to the postoffice administration, and were not under the control of the contractors who are carrying out the experiment.

It is merely an experiment, but it is an experiment that has been carried out in a very practical manner, and they are threshing out a question that may be of importance.

They find that the tube used is too small for their purposes, and they are going to use in future an 8 inch tube.

DISTRIBUTION OF TIME.

A feature of considerable interest and novelty is the distribution of time by the Western Union company. Correct time is received every day at noon from Washington. The time current lasts one second. Time balls are dropped at Boston, Newport, Woods' Holl, New York, Philadelphia, Baltimore, Washington, Fortress Monroe, Savannah, New Orleans and Havana. This current is also distributed by the Western Union company to subscribers in the principal centers. In New York there are 1,100 subscribers, in Chicago there are 1,837, while in the whole of the Western district of the company there are 7,963 subscribers. Each of these subscribers has a special wire upon which the time currents are sent from a master or a controlling clock. The Western Union company also furnish synchronous self-winding clocks to the subscribers, which are controlled and regulated daily by these time-signal currents. They are wound by current automatically every hour.

The rates for this service are not excessive. Each subscriber is charged $2.25 per month, while large buildings using five or more clocks get the time signal supplied at $1 25 per clock per month.

The standard time adopted in 1883 is virtually Greenwich time. It is divided into four sections. The following table will show how far these differ from Greenwich mean time and from each other:

W. Long.	Center.	Actual Time.	Name adopted.
0°	Navigators' time (Greenwich)	Noon.	Greenwich time
75°	Washington Meridian.	7 a. m.	Eastern time.
90°	Chicago Meridian.	6 a. m.	Central time.
105°	Denver Meridian	5 a. m.	Mountain time.
120°	San Francisco	4 a. m.	Pacific time.

Thus the minutes and the seconds are the same as with us. There is no necessity to alter one's watch.

Hefner von Alteneck proposes to place clocks in the circuit of an ordinary glow lamp, and to wind and control them by a slight change in the current made at the central station once a day. It is surprising what can be done by electricity when it is laid on in a house and served from a central station.

Von Alteneck's system was exhibited at the World's Fair.

CONCLUSIONS.

It is quite impossible to inspect the telegraph system of the United States and compare it with our own system without drawing comparisons between the way in which the work is done in the two countries. The result of my previous visit was to confirm my view that we do our work better in England than they do in the States. Our apparatus is better, our speed is higher. Messages are handled with greater reliability. A message can be sent and its reply received with certainty in an hour in England. I fancy such rapidity would astonish the users of the telegraph in the States, except those in such busy centers as New York and Chicago, and generally the speculative branches of the community.

The domestic telegram scarcely seems to have reached the United States, and this is owing probably, to the fact that the districts of private residences, the small towns and the villages do not possess telegraph offices, unless they are supplied by the railway company at the railway station, or by the Western Union company, which does the work for the railway company.

I fail to see any superiority in the manipulation skill of American operators. They certainly have not made the same advance in technical education that we have, and altogether it may be said that the management of the telegraphs in the States in the hands of private enterprise does not compare favorably with the managment of the telegraphs by the state at home. At the same time, it must not be assumed, because the government has advantageously taken the telegraphs in hand at home that such a process would be possible in the States. In my opinion it would be absolutely impossible. The civil service of the States is in a very chaotic condition. The principal appointments are four-year appointments only, and are filled politically. The principal postmasters come in and go out with each new president. We in England scarcely consider that a postmaster is fit to be a postmaster until he has had many years' experience of the working of the post-office system. In the States a man is made a postmaster because he has been a political supporter. At one or two offices I found the new postoffice officials absolutely ignorant of simple facts they ought to have had at their fingers' ends. A business like that of telephones or telegraphs can only be conducted properly by those who possess a considerable amount of enterprise, and who look primarily to the necessities of the community. The reason why our postoffices and our telegraph offices at home work so well is because the public exercises such a useful and such a determined supervision over the work. The free opening of the press to complaints; the criticisms to which the public service is subjected; the readiness with which members of the House of Common ask questions—though at times, perhaps, irritating and vexatious—are undoubtedly good for the service, for they keep us all alive. Such a state of affairs is impossible in the States.

The government of the United States must first reform its civil service, and when it gets officials into the service whose tenure of office is secure, and whose zeal is as unquestioned as it is in England, then there will be some chance of its government acquiring the telegraphs; but under existing circumstances the acquisition of the telegraphs by the government of the United States would amount virtually to the deterioration of the service. The commercial management is at present, as I have pointed out, characterized by great energy. I do not, however, acknowledge that they show greater energy than we do in England. Competition may make it more conspicuous, but it is not more reaching. Our speculative business, stocks and racing, is done as well as theirs.

The telegraph management at home is characterized in all particulars with similar energy to that which I observed in the States; and I come back without any views or wrinkles which I think could be impressed with advantage on the commercial or technical management of our system at home, unless it be the encouragement of offices in hotels, for it is found everywhere that a telegraph office at one's door prompts the desire or want to telegraph.

The capital of the Western Union Telegraph company was in 1877 $22,000,000; that of the British Postoffice was £10,000,000. The capital of the former is now $123,000,000, while that of the latter remains virtually the same. Scarcely a single vestige of the old telegraph companies' systems purchased by the state in this country now remains. Whence, therefore, this splendid system of cables, underground lines, and new pole lines in this country, spreading everywhere, and transacting an annual business of £2,500,000, instead of the £600,000 handed over to us? It has all been paid for out of revenue! The government keeps no capital account.

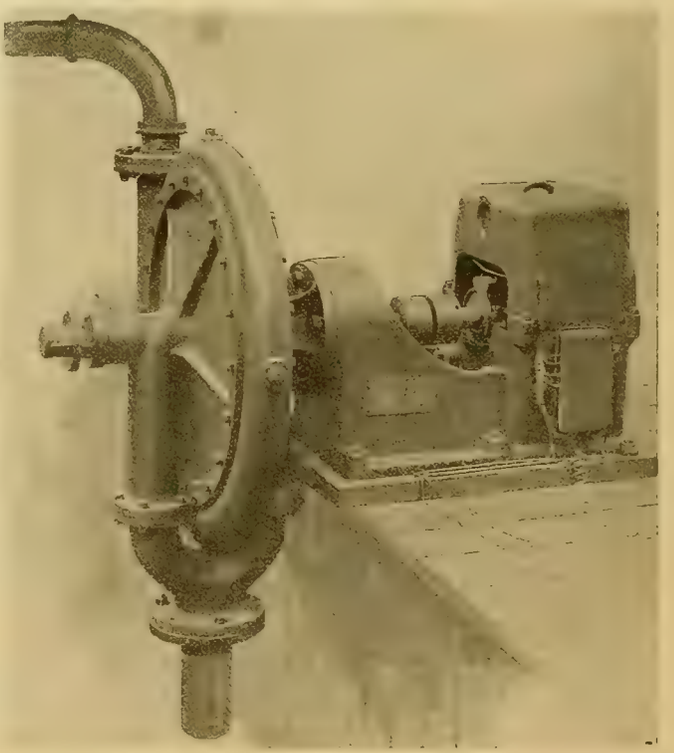
How do we do our work? The proof of the pudding is in the eating thereof. The criterion of telegraph working is rapid despatch. "Time is our only competitor," said Dr. Norvin Green. The time occupied in its transit from the hands of the sender to those of the receiver is the pudding. The whole of the messages arriving in Newcastle on the morning of January 20th were examined and analyzed. The mean time of transit from all parts of the United Kingdom averaged 7 8 minutes. A similar examination at Glasgow on January 15th gave a mean result of 8.7 minutes. This cannot be beaten, and it certainly will not be believed. The late Mr. Patey was once asked why express telegraph service at higher rates was not introduced in England. His answer was, "All our messages are express already."

Incandescent Lamp Litigation.

In the United States Circuit Court of Appeals at Boston, on February 9th, a decision was handed down by Judges Putnam, Nelson and Webb in favor of the Edison Electric Light company against the Davis Electrical Works. The suit was brought by the Edison company against the Davis company for the alleged infringement of its incandescent lamp, and the case was heard by Judge Colt in the United States Circuit Court, which resulted in a temporary injunction being issued restraining and enjoining the Davis company from making the lamp. The Edison company claimed that the Davis company bought up lamps that were worn out by use, and in which the filament had been destroyed. These were purchased at a small price, and after reconstruction were sold by the Davis company as "repaired" lamps.

Electric Centrifugal Pump.

Among the many types of electric pumps exhibited by the General Electric company in its power and mining section at the Chicago exposition, the electric centrifugal pump, ejecting its broad stream of water into the reservoir in electricity building, attracted considerable attention. The pump itself is a No. 4, four inch centrifugal pump,



ELECTRIC CENTRIFUGAL PUMP.

manufactured by the Lawrence company. The shaft of the pump is directly connected to the shaft of the armature of a General Electric iron clad No. 2½ water proof motor, running at 400 revolutions, at which speed it developed three horse power. This pump, a cut of which is presented, is intended for use where muddy or dirty water is encountered, which would quickly destroy the usefulness of the valves of an ordinary pump. It has proved remarkably efficient wherever it has been used, especially in raising water for irrigation purposes

The Metropolitan Electric Company in its New Home.

When it was announced last year that William H. McKinlock and Walter C. McKinlock, the latter at that time identified in the electrical supply business as the organizer of the Enterprise Electric company of Chicago, had perfected a business arrangement whereby the interests of the Enterprise company and those of William H. McKinlock became united, it was predicted that the new Metropolitan Electric company, under the management of two such shrewd business men, would pursue an aggressive policy that would eventually lead to success. Despite the inauspicious condition of business in general, the new organization was soon in need of a new store, and the advantages to be gained by combining offices, salesroom, store-room and shipping department. About the first of the year the change was made from the old quarters to the new and spacious store at 186-188 Fifth avenue, where the company now enjoys every advantage for conducting its business. The fact of the company seeking the wholesale district of the city is illustrative of the broad policy which it is pursuing in extending its field. The retail trade has not been lost sight of, however, and the officers of the company are always at home and at liberty to talk with old friends whether upon matters of business or for the sake of extending their reputation as popular and well-known gentlemen.

An excellent idea of the arrangement of the interior of the store may be gained by a glance at Fig. 1. The room on the ground floor is 50 feet wide by 100 feet long, and here are located the general offices, the cozy private office of the president, the cashier's and stenographer's department, the sales department and the shipping room. It is in its improved shipping facilities that the company has gained a decided advantage in its new home. No partition intervenes between the salesroom and the shipping room, so that the packing of goods is always under the personal supervision of the salesman. Every opportunity has been given for admitting as much natural light as possible and the front of the store is mostly of glass. Fig. 2 shows the neat external appearance of the store as well as reproducing the trade marks of the company's specialties as they appear upon the windows. Under the salesroom, in the basement, 50 by 110 feet, is the store-room, extending under the sidewalk, thus affording storage room for particularly inflammable materials in accordance with the requirements of the underwriters. In this basement are

FIG. 1. THE METROPOLITAN ELECTRIC COMPANY IN ITS NEW HOME.

stored large quantities of N. I. R. insulated wires and cables of all sizes and capacity, carbons, barrels of incandescent lamps, P. & B. compounds and all those numerous articles which go to make up the stock of a company engaged in the general electrical supply business. With such ample storage room and shipping facilities, the Metropolitan company has every opportunity for attending promptly to all orders.

The specialties handled by the company are recognized as being of a high order of merit. Prominent among these is N. I. R. wire. The National India Rubber company, the manufacturer of this wire, has recently extended its field, and it now embraces in its output all lines of insulated wires and cables. The Metropolitan company is the general western agent for this wire, which is of the highest quality and meets the demands in all particulars for a high grade insulator. The line now embraces electrolier wire, telephone twin wire, rubber tape, lamp cord, rubber tubing and concentric wire, in addition to the former applications. One of the latest specialties to be placed upon the market is the Metropolitan incandescent lamp. This lamp is of an improved design, made in all the standard candle powers. The Paiste products, including switches, cut-outs, bushings, clutches, etc., constitute an important factor in the business of the company, which is also the general western agent for the Standard Paint company's P. & B. compounds. In the list of specialties mention must not be omitted of "Mac" tape, which is of particular value for armature and field magnet wrapping, and which possesses many merits which are worthy of consideration. It has superior insulating qualities, and is made to withstand the most severe of climatic changes. It will not oxidize the wire, and its adhesive qualities are such that it is practically indestructible and consequently does not appreciably deteriorate with age. The company intends placing the new Metropolitan transformer upon the market in a couple of weeks, and it is safe to assume that this specialty will equal in efficiency and worth those others which bear the mark "Metropolitan." J. J. Nate, well known to the electrical trade from his long connection with the telephone business, was lately secured as manager of the company. Mr. Nate's personal qualities particularly fit him for this position, and there is no doubt that the company will be materially benefited by his connection with it. William H. McKinlock occupies the position of president and Walter C. McKinlock acts as secretary. There is always a hearty welcome at 186-188 Fifth avenue.

FIG. 2. THE METROPOLITAN ELECTRIC COMPANY IN ITS NEW HOME.

Reorganization of the Mather Electric Company.

For some time there has existed a project to transfer the Mather Electric company of Manchester, Conn., to a syndicate of well known Hartford capitalists. The several details of the transfer have been arranged, and the new men have taken charge of the company and its affairs. At a meeting of the stockholders at the Phoenix National Bank at Hartford the following named officers were chosen: Maro S. Chapman, president; T. C. Perkins, vice-president; John L. Bunce, secretary and treasurer. The following named directors were chosen: Charles E. Perkins, T. C. Perkins, M. S. Chapman, Henry A. Redfield, Charles M. Jarvis, John L. Bunce and Norman McD. Crawford.

Charles E. Perkins is the well known patent lawyer expert. T. C. Perkins, his son, is familiarly known to the electrical fraternity of the West, through his connection with the Ball & Wood Engine company of New York, Mr. Perkins in connection with W. P. Pearson representing this firm as its western managers. Henry A. Redfield is the president of the Phoenix National Bank. Charles M. Jarvis is president of the Berlin Iron Bridge company of Berlin, Conn. M. S. Chapman is manager of the government envelope works at Hartford, and a largely interested stockholder in a number of paper mills in New England. Mr. Crawford is the consulting engineer for the Pennsylvania Traction company of Philadelphia and also of the Pennsylvania Railroad company, being also retained as electrician of the Hartford Street Railway company. Mr. Bunce has been connected with the Perkins Switch company of Hartford, the Schuyler Electric company and with the Pope Manufacturing company of Hartford. Theodore Gonet, who has been retained as electrical engineer, was connected for some time with the Westinghouse Electric & Manufacturing company. He will have associated with him W. E. Powell, who for many years has been identified with the Mather Electric company. It is stated that the company starts out under the reorganization free from all debt and with a capital stock of $250,000. The intention of this company is to make a specialty of large dynamos and generators for electric lighting plants and electric street car systems.

Prof. Thomson's Plans.

The story circulated quite extensively to the effect that Prof. Elihu Thomson was about to leave the General Electric company was denied in the WESTERN ELECTRICIAN of February 3d. In a communication on this subject Prof. Thomson says:

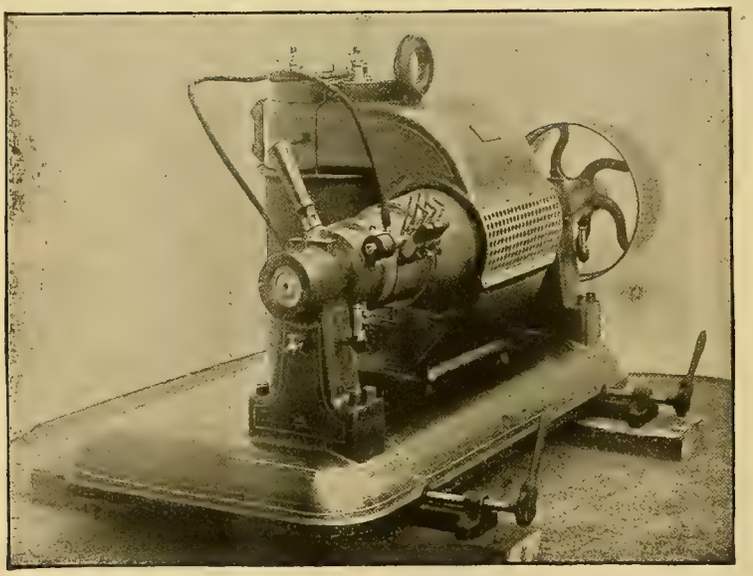
You are at liberty to publish as coming direct from m the statement that there is no truth whatever in the stori which have been sent out by various newspapers, such the New York *World* to the effect that I am about to ganize a new company in opposition to General Ele

company. The whole story is a fabrication, probably for the purpose of affecting the stock market.

I have, on the strength of the story, been the recipient of numerous offers of services, of bargains in patents, of financial support and general inquiry, which has had a serious effect in adding to my correspondence and causing loss of time. Your assistance in correcting the absurdly false story will be appreciated.

The Colburn Dynamo.

In the accompanying illustration is shown a dynamo manufactured by the Colburn Electric Manufacturing company, Fitchburg, Mass. This style may be taken a typical of the class of machines made by this concern, for although the machines designed for different circumstances differ in outward appearance the electrical and mechanical design are the same. A general description will answer for all sizes and types. They have direct poles, a shortest possible magnetic circuit and one field coil, giving the greatest possible amount of magnetism in poles. The coil is wound upon a bobbin that easily takes off. A wrought iron magnet core with an extra large magnetic contact with poles is employed. One end of the pole is cast solid to the magnet core, the other end is cast on a taper, keyed and bolted. The poles have extended arms, which after being bored, and the boxes turned to same diameter and bolted into place, insure perfect alignment for bushings in which the armature shaft runs. Every part of the machine upon which wear comes is made in duplicate, and can be easily exchanged. The armatures in most of these machines have but one



THE COLBURN DYNAMO.

convolution of wire for each segment in the commutator which is made of tempered copper, thus giving a special large face commutator and allowing of a greater variance of brushes and still be upon the non-sparking point whether the machine is working under or a little over its capacity, or running over or under its rated speed. This non-sparking point, which is of the greatest importance, covers a particularly large space. The field is of high resistance and the armature of very low resistance; with this combination the machine is automatic in its regulation, and especially economical, having a very high efficiency. The armature is of a novel construction, with special winding, finely laminated best soft iron washers, and shaft of Firth's English tool steel.

The larger machines have a chain oiler that carries oil from a well to the shaft, giving constant circulation o oil. In this construction the armature is above the field magnets, away from dirt. The working parts can more easily be seen and attended than when the armature is under the machine. It is finely balanced, once before winding and once after. The machine runs perfectly steady and free from vibration.

The Page Belting Company Threatens a Libel Suit.

Reference has already been made to the copy of the St. Gaudens medal which the Page Belting company has been sending to the trade. The reproduction, it seems, did not meet with the approval of Mr. St. Gaudens, and that artist is credited with having expressed himself in such a forcible manner that he has been addressed by the company's lawyers as follows:

It is stated that you have called this company "dishonest" and "dishonorable," and its agent, who obtained a copy of the design made by you for the Columbia medal, a "thief." Alleged interviews published in the Washington *Post*, the *Chicago Mail*, the Cincinnati *Enquirer* and the New Hampshire *People and Patriot* report you as making use of the foregoing language, and we are informed that these or similar interviews containing the words "thief," "dishonest" and "dishonorable," as applied to this company and its agent, have been published in newspapers, additional to the list above given, in various parts of the United States. We shall investigate this matter further, but the information already secured is enough for us to call upon you for a statement of the facts. Did you make use of the word or words "thief," "dishonest" or "dishonorable" in connection with this company and its agent? If you did not use these words, we call upon you for a denial of the statements above referred to. If you did make use of these words, we propose to bring suit against you for libel, and we shall hold you responsible for the damage already done or that shall be done to this company by your libelous language, unless you make a complete retraction and an ample apology.

It is very evident from the above that the Page Belting company is willing to have the matter thoroughly investigated and ready to show how it obtained the reproduction of the medal in question.

Electrical Canal Project in Maryland.

The substitution of electricity for mule power on the Chesapeake and Ohio canal will, it is believed, determine its continuance as a waterway, writes the Baltimore correspondent of the *New York Tribune*. A petition for the ratification of the contract between the trustees of the canal and the Chesapeake and Ohio Transportation company for the purpose of introducing electric power on the canal will be heard in the Hagerstown Court on February 15th. The agreement between the trustees and the company gives the latter control of the canal for ten years, the company guaranteeing that the net profits shall not be less than $100,000 a year. When the organization of the new company was recently announced it was stated that the Baltimore & Ohio Railroad company was largely interested in it, and that if the canal did not pay better when operated by electricity than under the old system the costly ditch would be filled up and tracks laid for a coal road. Electrical engineers and the promoters of the new company, however, are confident that the waterway can be operated profitably, and that it will pay the railroad company better than it would by turning it into a railway.

Test of a Long-distance Telephone.

Last Saturday night a test of the long-distance magneto telephone used by the Western Telephone Construction company, Chicago, was made between New York and Chicago under peculiar circumstances. The instrument handled by this company is the Strombrey magneto telephone, and it was thought necessary by the company, before pushing its sale as a long-distance instrument, to have some authentic test made upon which to rely and which would be of such a character as to place the telephone under the hardest conditions required in long-distance service. There was one serious obstacle in the road to a test between New York and Chicago, and that was that the company did not own a line between the two cities, and it was not to be expected that the Bell people would authorize the means of their possible discomfiture, for that corporation has always cheerfully claimed that for such long distance purposes a magneto telephone was out of the question. A means was found, however, and last Saturday night several men connected with the Postal Telegraph company and some officials of the telephone company went to an office in New York where the Metropolitan Telephone company has long-distance wires. One of the party took off the Bell instrument and made connection with the transmitter and receiver of the magneto telephone, which had been brought to the office securely wrapped, the better for concealment. One of the party called up the central office, secured connection with Chicago and talked with an associate here for some time. The test is said to have been of a very satisfactory character and demonstrated to the satisfaction of those concerned that their instrument was as applicable to long-distance service as could be desired.

Proposed Sub-sidewalk Railway.

Among the various projects for rapid transit in Chicago is one proposed by J. H. Farrar, a real estate dealer, who advocates an electric railway to be operated in the space under the sidewalks. Mr. Farra thus explains his plan:

This projected road is not for the purpose of furnishing a down-town loop for elevated roads, but to provide rapid transit from the business center to all parts of the city. Several architects have examined the sidewalk space for me, taking actual measurements and giving the elements of restriction full scope. The full space of sidewalks is more than sufficient for the plan, as a space of 6 by 6 feet will answer every purpose. It is proposed to dress the walls of the space with a smooth coating and substitute for the sidewalk now in use another of prismatic glass which will render the space light as a room. Stations at the various corners are provided. By an easy flight of steps, no longer than those to an ordinary basement, passengers will reach trains.

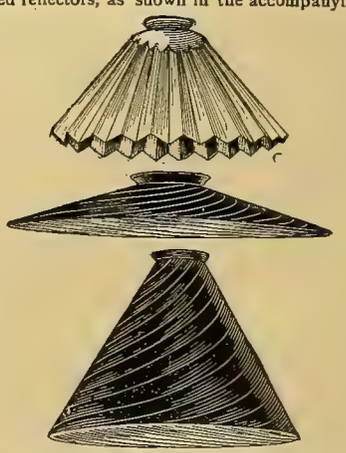
An entirely practicable plan of rapid transit by electricity is involved. Two insulated rails are laid in the space. They are carriers of the current, which will be supplied from a number of power stations. We intend to use an exceedingly light and unroofed car. Practically it is a platform with a seat running completely around the edges. Passengers sit with their backs to the walls of the space. They enter the car at an opening left on one side. Our trains being composed of light cars encounter only a nominal expense in stopping and starting. Practically they can be run at the highest speed. It is intended to push the tracks into all parts of the city.

Storage Battery Litigation.

The Brush Electric company and the Consolidated Electric Storage company, as co-complainants, have sued the Electric Storage Battery company and W. W. Gibbs, president, in the United States Circuit Court for the District of New Jersey, for alleged infringement of the Brush storage battery patents, recently sustained by the United States Circuit Court of Appeals, more especially patent No. 337,299. The motion for a preliminary injunction will be heard before Judge Green at Trenton on February 20th.

Gleason's Standard Silvered Glass Reflectors.

The E. P. Gleason Manufacturing company, New York, which is constantly adding to its large line of appliances for electric lighting, is now in the market with new styles of silvered reflectors, as shown in the accompanying cuts.



GLEASON'S STANDARD SILVERED GLASS REFLECTORS.

They are made in shapes of the staple electric shades, radial fluted and spiral corrugated, richly silvered inside, enameled green outside, greatly assisting the candle power of electric lamps. The reflectors are always bright, do not tarnish, and are easily cleaned. One of the features of these reflectors is that they are particularly simple in their design and construction.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 12.—The rapid transit commissioners met February 8th in private session. They did nothing but examine the progress of the work on the proposed independent elevated railroad. They expect that all the preliminary work on that plan will be done by the latter part of next week, and that a report can be given to the mayor immediately afterward.

The rapid transit committee of the Chamber of Com-

merce met the same day behind closed doors. The Wilson plan was discussed for three hours. The clause in the plan which relates to the city lending its credit was the principal topic under consideration, and although no report was made public its decision is understood to be favorable to the idea of the city lending its credit to further the Wilson plan. The committee drew up a long report on rapid transit, which will be submitted to the chamber at its special meeting next Thursday. It is announced that John H. Davis & Co. have withdrawn for the present from the rapid transit problem.

A decision was rendered on February 9th in the Court of Appeals against the Edison General Electric company. The proceedings were in relation to the assessment for taxation on the company's capital stock for 1892. The capital, stock was first assessed at a valuation of $15,000,000 but afterward deductions were allowed, bringing the amount down to $2,670,700. The company then claiming that it should not be assessed for any personal property whatever procured a writ of certiorari, alleging that its gross assets exclusive of its patent rights, were $9,459,500, against which deduction should be allowed amounting to $11,185,474. The Special Term dismissed the writ upon the evidence, and the General Term affirmed its decision. The company's showing against the assets was: Indebtedness, $4,740,174; real estate otherwise taxed, $802,500; stocks of other corporations, $3,526,800, and property permanently invested in other states, $2,116,000.

Mayor Schieren is determined that corporations shall fatten no more off the city of Brooklyn by job contracts. For a long time past the Citizens' and Municipal companies have been lighting the streets with electricity for $182.50 per light per year. The board of aldermen has, with his honor's approval, rejected all bids for street lighting, so as to give other than the two companies which have hitherto enjoyed the monopoly a chance to offer bids. At the recent bidding the Citizens' company reduced its offer from fifty cents to thirty-nine and a-half cents per light a night, but Mayor Schieren demanded a price lower still. He believes that thirty-five cents will net a corporation a profit. The old companies are loud in their prostestations that they can make no money at that rate.

The Brotherhood of Electrical Workers, which has a membership of over 800 in this city, has prepared a bill for introduction at Albany providing for the licensing of all persons who install electric equipment in buildings. The mayor of each city of the state is to appoint a board of three examiners, who shall determine the qualifications and give a rating to all electrical workers. The bill has been drawn in accordance with the following suggestion contained in Governor Flower's latest message to the Legislature:

It has also been brought to my attention that part of the recent increase in fire losses is attributed to the improper wiring of buildings where electricity is to be used for light or power, and the suggestion has been made that persons installing electric equipment in buildings should be compelled to show licenses certifying to their fitness for the work and issued by a competent board of control, very much in the same manner that steam boiler inspection and certification are now required.

The bill says that members of the board shall not be connected with any firm or electrical corporation. All its findings shall be based upon the insurance laws of the state and the rules of the Board of Underwriters of this city. The board shall have the power to compel the attendance for examination of every person engaged installing or operating electrical apparatus in any city of the state, or who may desire so to engage. All applicants for examination and rating by the board shall have served at least three years at any one or all branches of the trade. Any employer failing to comply with the spirit and letter of the act is liable to a fine of from $25 to $250. Any employe or prospective employe who fails to comply with the act is punishable by a fine of from $50 to $250. It is made unlawful for any insurance company doing business in the state to take a risk on any property where the requirements of this act have not been complied with.

Secretary Herbert appointed a master electrician at the New York Navy Yard on February 6th. There was an examination on January 23d of forty-one applicants for the place, which is in the department of equipment. The candidate who was recommended by the board of examination was J. Martin of New York. He is already an employe of the department of equipment, and has been doing the work of an electrician. He is the man appointed by the secretary.

W. F. O.

The electric lamps in the Board of Education building, at Columbus, O., have been removed, and the lighting will hereafter be done by gas. It was determined that the electric lighting was carried on at too high a cost.

PERSONAL.

George K. Fisher, mechanical engineer, late of Denver, has removed to Chicago, with an office at 1419 Monadnock building. Mr. Fisher has been successful in designing mill and smelting plants.

The friends of George G. Carter, well known to the electrical trade of Chicago, and vicinity, are expressing sincere sympathy on the death of his wife, which occurred a few days ago. Mrs. Carter, who was a most estimable lady, had long been an invalid.

Carl Kammeyer has been appointed western representative of the *Electrical Engineer*, with headquarters at Chicago. Mr. Kammeyer is well known in this field, having been connected with the National Electric Manufacturing company of Eau Claire, Wis., for several years.

C. H. Macloskie, formerly electrical engineer of the Intramural railway at the World's Fair, has formed a connection with B. J. Arnold as a consulting engineer, and both may be found at 565 Rookery, Chicago. Mr. Macloskie has established a reputation as an able engineer and will make a specialty of electric railway practice.

The friends of George M. Phelps, president of the *Electrical Engineer*, will learn with sincere regret of the death of his wife, who died February 10th, after a brief illness of two weeks. Mrs. Phelps was well known in society circles and highly respected by all her acquaintances. The remains were taken to Troy, N. Y., for burial. Mr. Phelps has the sympathy of the entire electrical fraternity in his bereavement.

NEW INCORPORATIONS.

Metropolitan Electric Equipment company, New York, N. Y.; capital stock, $20,000.

Fisher Electrical Manufacturing company, Detroit, Mich.; capital stock, $50,000.

Union Electric company, Portland, Ore.; capital stock, $5,000; equipping electric railways, etc.

Mason Electric company, Chicago, Ill.; capital stock, $10,000; to do a general electric railway supply business; W. R. Mason, Chicago, Ill.

Healdsburg Electric Light & Power company, San Francisco, Cal.; capital stock, $25,000; to furnish light and power for Healdsburg, Cal.; A. H. Babcock, Oakland, Cal.

People's Electric Railway company, Holyoke, Mass., capital stock, $100,000; to build an electric road to connect South Hadley Falls and Willimansett with Holyoke, Mass.

ELECTRIC LIGHTING.

Onawa, Ia., is soon to be electrically illuminated.

Fennville, Mich., has contracted for arc lighting in the town.

An electric lighting plant will probably be established at Wynne, Ark.

A $10,000 fire occurred at the electric light station at Prospect, O., recently.

A company with a capital stock of $10,000 will establish an electric light plant at Dawson, Ga.

The city of Kaslo, Wash., has purchased the charter of the Kaslo Electric Light & Water company.

Winona, Minn., is discussing the question whether the city ought to own and run its own electric plant.

Brunswick, Mo., has voted to bond the town for $10,000 for an electric light plant and waterworks.

It is more than likely that the gas and electric lighting interests of Lawrenceburg, Ind., will be consolidated.

A bill was passed in Columbus O., February 7th to secure an electric lighting plant in the capitol building.

The Atchison, Kan., Gas & Electric Light company reports a steadily increasing business in both departments.

Janesville, Wis., is to have electric lights. A committee of the common council has the matter under consideration.

Steps are being taken in Valparaiso, Ind., to furnish the town with electric lights. A plant will probably be installed soon.

Opelika, Ala., is soon to have an incandescent electric light plant. A telephone exchange is also contemplated for the place.

A company, with a capital stock of $50,000, has been organized to establish an electric lighting plant at Benwood, W. Va.

The people of Boscobel, Wis., are endeavoring to secure electric lights. It is expected that a plant will soon be installed.

The Lewistown, Pa., Electric Light company has purchased the Lewistown gas works. The price paid is said to have been $10,000.

After one month of darkness the electric lights at Mankato, Minn., were turned on again February 4th. A misunderstanding between the city and the electric lighting company in the meantime had been amicably arranged.

Proposals are invited by the Board of Public Works, San Diego, Cal., until March 22d, for the public lighting of the city. The proposals call for arc lamps of 2,000 candle power. The contract is to be for one year beginning April 1, 1894.

ELECTRIC RAILWAYS.

The project of an electric railway between Burlington, Vt., and Hinesburg is being discussed.

The Montreal, Que., Electric Street Railway company has bought the privileges of the Standard Light & Power company in Ste. Cunegonde and St. Henri.

Employes of the Cleveland, O., Electric Railway company have been arrested on the charge of running cars at a speed greater than that permitted by the city ordinance.

The officers of the Alton, Ill., Electric Street Railway company are making an effort to raise money with which to begin the construction of the North Alton line early in the spring.

It is stated that traffic has been augmented one hundred per cent. on Philadelphia's new trolley lines on Thirteenth and Fifteenth streets. It is reported that the cable line will be electrically equipped next year.

The Pennsylvania Traction company is considering the advisability of running a branch of the proposed electric railway in Lancaster, Pa., to Oxford. The plan is to connect it with the main line of the electric railway at Parkesburg.

The plan of changing the existing horse car line in Freeport, Ill., into an electric road is being considered, and it is likely that the necessary steps to insure electric traction will soon be taken. The road is about six miles in length.

An ordinance permitting the Delaware River Steamboat company to lay trolley tracks and establish an electric road in Bristol, Pa., for which the company has been contending for a year, was finally passed at the borough council meeting last month.

The Mount Vernon, N. Y., Common Council has granted the West Chester Electric Railway company permission to run horse cars over its tracks on Fourth avenue on certain conditions, one of which is guaranteeing to supplant horse power with electricity by the first day of June, 1894.

A meeting is said to have taken place at St. Catherines, Ont., a few days ago, between some Buffalo gentlemen and the promoters of the Hamilton, Grimsby & Beamsville railway, in relation to the scheme for utilizing for electrical purposes the waste power at the DeCew Falls, near St. Catherines.

A foreign contemporary states that the Heilmann electric locomotive, which was described in the WESTERN ELECTRICIAN about a year ago, has been tested on the railway between Paris and Havre. It was attached to a train of 13 cars, the account declares, and attained a speed of 75 miles an hour.

Conroy Bros. propose to utilize electric cars operated by storage batteries to draw wet lumber and refuse from their sawmills at Deschenes, Que., through the piling grounds. It is also said to be the intention of the firm to install a dynamo from which to supply current for lighting the streets of the town of Aylmer, Que.

The West End company of Boston, on its Ashmont and Milton branch, which crosses several wide steam road tracks, requires the conductors to light the electric lights in the cars as an additional safeguard. The operation is said to have saved several accidents, as the most careless conductor can keep watch for failure of current by that means.

Steps are being taken to build an electric railroad for freight and passenger service between Kingston, N. Y., and Ellenville, a distance of twenty-eight miles. This route is through a fertile and valuable farming country of Ulster county. Meetings have been held in several villages, where the scheme has been agitated and committees appointed to secure the right of way.

At a meeting of the residents of Lake View, Chicago, on Saturday evening, there was a unanimous declaration in favor of granting Mr. Yerkes permission to substitute the overhead electric trolley system for horses on North Clark street and Sheffield avenue. It was the first of the numerous meetings held by the residents of that part of the city at which there was not some manifestation of dissent to the trolley system.

The Braddock, Pa., electric railway, which has not been in operation for over a year on account of difficulties with the township authorities in regard to its construction, will be extended to Edgewood. There it will connect with the Duquesne road, making a continuous line to Pittsburg by way of the Wilkinsburg branch of the latter. Arrangements were made at a meeting with supervisors of Braddock township to this end by the officials of the road.

In Bath, Me., the electric street cars are used, it is said, by the city authorities to inform parents on stormy days whether school will keep. They have had big signs painted, bearing on one side the legend, "No School," and on the other, "One Session." These, with the appropriate side displayed, are placed on the forward fenders of electric cars, so that the public along the line of the railway only has to watch to know whether to send their children out or not.

TRADE NEWS.

The Lunkenheimer company, sole maker of the Lunkenheimer specialties, Cincinnati, O., has gotten out a small folder illustrating by comparison the merits claimed for the Lunken renewable seat gate valve. These gate valves are simple, strong and compact, and many ideas in buying and ordering may be gained by examining the company's folder.

The Colburn Electric Manufacturing company, Fitchburg, Mass., is sending out several well illustrated books,

descriptive of its type of dynamos and motors. The Colburn dynamo is illustrated and described elsewhere in this issue. These books are compiled in an attractive manner and explain in detail the operation of this style of machine.

A. O. Schoonmaker, importer of India mica, 158 William street, New York, is sending to the trade a price list and descriptive sheet of his quality of mica. This mica is sold in the solid sheet as it is mined in the mines of India. It is selected stock of absolute purity. It is perfectly free from iron, thus rendering its non-conducting properties of the highest order. It splits evenly throughout and has a uniform, smooth cleavage.

One of the Royal Blue Line trains of the Baltimore & Ohio Railroad company, on a recent run between New York and Washington, covered a mile in 39½ seconds as recorded by a mechanical indicator. At this rate the train traveled at the phenomenal speed of a trifle over a mile and a half a minute, or over ninety miles an hour, which probably surpasses all previous records of fast time. If the speed were maintained the time between New York and Washington would be reduced without stops to two hours and a half, and with stops to three hours. Five hours is now the fastest time between the two cities, and it is made daily by the Royal Blue Line.

The applicability of storage batteries for central stations, power plants and large isolated installations has been considered in a book published by the Consolidated Electric Storage company, New York and Philadelphia. The work is full of interesting facts and statistics, and is a treatise that central station men should read. The following extract gives an idea of the purpose of the book: "The monthly sales of storage batteries of one factory in Germany amounts to $125,000; an English storage battery company approximates this figure, and Paris, with its 30 storage battery central and sub-stations, must create a considerable demand. Why is this country so far behind? We must seek the cause first in the unsettled condition of the business arising from a prolonged and bitter litigation, and secondly, in the fact that economics are not so closely sought after here as in Europe."

J. L. Barclay has moved into his new business quarters on the sixteenth floor of the south end of the Monadnock building, which seems to have become the center of electrical trade in Chicago. The suite of offices secured is well adapted for Mr. Barclay's electrical interests, and was primarily selected by him for exploiting the Walker Manufacturing company's electric railway and power machinery, the central and western departments of that company's business being under Mr. Barclay's immediate supervision and management. H. McL. Harding, who is also interested in the company, has his headquarters, for the eastern department, in New York. While the general electrical interests of the Walker Manufacturing company will receive the combined attention of Messrs. Barclay and Harding, all business directly connected with the Western and Middle States will be transacted at the Chicago headquarters. The appointment of district and sales agents is now receiving attention, and little trouble is encountered in securing competent men. Mr. Barclay feels much encouraged at the business outlook, notwithstanding the financial depression. Inquiry for the heavy types of generators and motors, such as the Walker company manufactures, are numerous. A description of these machines will be published soon.

BUSINESS.

Goodhue & Lincoln, Chicago, report a large and increasing business since the first of the year. They carry several well known specialties, such as the Sunbeam lamp and Wagner motors, besides a number of others which have proven ready sellers.

To meet the demand which has existed for some time for a stock of high grade electric light carbons, the Electric Appliance company, Chicago, has made arrangements to carry a stock of Crouse-Tremaine carbons sufficient to meet all reasonable demands for prompt shipments. The company is also prepared to bid on large quantity orders for direct shipment from the factory.

The Boston Motor company, 17 Batterymarch street, has made several improvements in the Boston motor and battery outfit and the Boston medical coil. They are similar in form to the original machine, but the base is made in one piece of a very durable and highly finished material, which has been found to be more satisfactory than the wooden base and iron frame that was first used.

Sprague, Duncan & Hutchinson, 15 Wall street, New York, have been retained by the government to draw plans and make specifications for the electrical equipment of the new Congressional Library building at Washington, D. C. It is intended that this plant shall be the equal of anything of its size in the country and possesses many features not before in use. There will be at least 7,000 incandescent lamps used.

The McLean Armature Works, 197 South Canal street, Chicago, have made a model of the Ferris wheel, to be exhibited in connection with the scenic railway at the midwinter fair in San Francisco, which has excited considerable interest. The model is decorated with 226 4-candle power incandescent lamps. There are, in addition, 90 lamps forming a star inside the center rim of the wheel. A number of other models are now being made by this concern.

The Sprague Electric Elevator company is now building a large factory at Bloomfield, N. J. Judging from the tools with which a large portion of the plant is being equipped, it is surmised that not only elevators but street railway apparatus will be manufactured. There have been many rumors of late that Mr. Sprague has some new inventions applicable to street railway work which he intends to bring out soon. When Mr. Sprague was asked regarding the matter he would say nothing further than that as an investigator he was always on the alert.

The E. P. Gleason Manufacturing company, 181 Mercer street, New York, is about to place on the market a large line of novelties in the way of reflectors, glass globes, shades, and other electric appliances in this line. The company reports a large increase in electrical trade during the past year. This concern was organized in 1865 with E. P. Gleason as president. E. G. Albee was elected vice-president and general manager of the sales department the first of this year. He has been connected with the firm for many years, and but few are better known in this line of trade. O. F. Gleason was elected treasurer, having resigned the position of general manager of the Gleason Knitting Mills of Seneca Falls, N. Y., which he held for several years, to accept this offer. Under the charge of the assistant general sales agent, W. F. Cullen, the electric department will be largely increased and broadened to meet the rapid growth of this business. Mr. Cullen has been with the Gleason Manufacturing company for many years. M. Wilfred Gleason has been appointed manager and superintendent of the glass works of this concern at Brooklyn.

The amount of business already brought to the offices of the Walker Manufacturing company of Cleveland, O., before a single machine has been offered for sale, is a gratifying evidence of the confidence displayed by railroad men in the ability of the company to furnish first-class dynamos and motors. Within the last two weeks the working force in the electrical department has been considerably augmented in view of the large amount of business now under consideration. Some of the improvements suggested have been found to effectually increase the output of the machines and give additional economy in construction. The armature winding of the motor possesses certain valuable innovations and improvements, tests upon it having recently brought forth the most gratifying results. Less than two months ago the details of construction were begun; yet within this time what has easily been accomplished would have taxed to the utmost the resources of almost any other company engaged in the manufacture of a new branch of industry. It is just such activity which serves to materially insure the confidence of the commercial world and bring business unsolicited where otherwise it would be diverted to different channels.

ELECTRICAL PATENTS.

Issued February 6, 1894.

513,975. Induction Mechanism for Electrostatic Instruments. William E. Ayrton and Thomas Mather, London, Eng.

513,982. Electric Conductor. Horace F. Chick, Watertown, Mass.

514,018. Cut-out Block. Edward J. McEvoy, New York, N. Y.

514,019. Circuit Controller. Edward J. McEvoy, New York, N. Y.

514,030. Load Governor for Electric Currents. Frank E. Pritchard, Oswego, N. Y.

The invention consists in a number of resistance bodies or coils connected to the electrical conductor, a series of movable contact pieces or arms connected to the other conductor, so that the contact pieces make successive connection with the resistance bodies. The movable contact arms are actuated by a governor similar to a steam governor.

514,037. Railway Switch. Augustin F. Schinner, Milwaukee, Wis.

514,047. Dynamo and Motor. Montgomery Waddell, Bridgeport, Conn.

514,056. Conduit Electric Railway. Rufus C. Beardsley, Lafayette, Ind.

A long shoe projects from the bottom of the car into a conduit, in which are supported several contact blocks at intervals less than the length of the shoe. Pivoted contact levers are so actuated by the shoe as to be brought in contact with said blocks, which are electrically connected to the main conductor, a spring being provided to restore the contact lever.

514,057. Hood for Electric Arc Lamps. Sigmund Bergmann, New York, N. Y.

514,058. Electric Arc Light Fixture. Sigmund Bergmann, New York, N. Y.

514,075. Electrical Measuring or Indicating Instrument. Samuel E. Hitt, Rockford, Ill.

514,077. Electric Motor. John D. Ihlder, Yonkers, N. Y.

514,078. Electric Elevator Motor. John D. Ihlder, Yonkers, N. Y.

514,083. Device for Preventing Railway Collisions. Gottfried F. Klaffky and Frank Faltinowsky, New York, N. Y.

514,087. Electric Shuttle Motion for Looms. Levi W. Lombard, Lynn, Mass.

514,088. Electric Shuttle Motion for Looms. Levi W. Lombard, Lynn, Mass.

514,089. Electric Shuttle Motion for Looms. Levi W. Lombard, Lynn, Mass.

514,090. Water Supply System. Samuel D. Love, New York, N. Y.

514,109. Electric Car Truck. Charles F. Winkler, Kingston, N. Y.

514,112. Closed Conduit Electric Railway. Frank M. Ashley, Hawthorne, N. J.

514,113. Electric Railway. Frank M. Ashley, Hawthorne, N. J.

514,114. Electric Railway Conduit. Frank M. Ashley, Hawthorne, N. J.

514,115. Electric Battery. Frank Bayer, New York, N. Y.

514,120. Electric Railway. Oscar A. Enholm, New York, N. Y.

514,128. Signaling System. Joseph G. Noyes and Louis Winterhalder, Milford, Conn.

514,131. Electric Meter. Carl Raab, Kaiserslautern, Germany.

514,133. Underground Electric Conductor. Henry A. Seymour, Washington, D. C.

The invention consists in inclosing the main conductor in a yielding envelope of insulating material, and providing the lower portion of said envelope with a conducting device adapted to be forced into contact with the main conductor by the pressure of a trolley shoe or wheel against it.

514,134. Closed Conduit for Electric Railways. Henry A. Seymour, Washington, D. C.

514,135. Motor Controlling Device for Electric Locomotives. Sidney H. Short, Cleveland, O.

Two shafts, one hollow and containing the other, are supported vertically within a post, a handle attached to each being within reach of the motorman. One shaft, through the means of links, operates a reversing switch, the other in the same way operates a rheostat switch.

514,139. Electric Arc Lamp. Gustavus G. Wagner, New York, N. Y.

514,140. Alternating Dynamo. James J. Wood, Fort Wayne, Ind.

514,146. Organ. Robert Hope-Jones, Birkenhead, Eng.

514,150. Commutator Brush. Jesse F. Kester, Buffalo, N. Y.

A lubricator leaf is provided between the commutator plates. The leaf is made up of a network of wires, in the meshes of which is contained the lubricating material, which is ordinarily solid, and only freed when melted by the heat resulting from the friction of the brush upon the commutator.

514,167. Electrical Conductor. Nikola Tesla, New York, N. Y.

514,168. Means for Generating Electric Currents. Nikola Tesla, New York, N. Y.

514,170. Incandescent Electric Light. Nikola Tesla, New York, N. Y.

514,202. Electric Alarm. Friedrich Sauer and Carl Hentzschel, Berlin, Germany.

514,212. Electric Signaling Device. James N. Connolly, New York, N. Y.

514,221. Insulator. Lawrence B. Gray, Boston, Mass.

514,228. Electrical Transmission of Power. Rudolph M. Hunter, Philadelphia, Pa.

514,229. Electric Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa.

This arc lamp is one adapted to be used for searchlights. The carbons are arranged at right angles, motor mechanism being employed to operate the horizontal carbon.

514,241. Magneto-electric Machine. Alward J. Potter, New Hartford, N. Y.

514,258. Temperature Compensating Device. William H. Bristol, Hoboken, N. J.

514,260. Secondary Battery. Hiram H. Carpenter, St. Louis, Mo.

514,267. Electrode for Secondary Batteries. Jules Legay and Lucien Legay, Fils, Levallois, France.

514,274. Electric Trolley Wheel Shield. Henry S. Pruyn, Hoosick Falls, N. Y.

514,275. Method of and Apparatus for the Electro-deposition and Refining of Copper or Other Metals. Lingan S. Randolph, Baltimore, Md.

514,276. Process of Electrolytic Separation of Nickel from Copper. Pierre DeRicketts, New York, N. Y.

514,279. Auxiliary Fire Alarm Telegraph. Joseph Sachs, New York, N. Y.

514,301. Rheostat. John T. Birch, Pittsburg, Pa.

514,303. Series Electric Railway. Michel A. Cattori, Rome, Italy.

514,304. Insulated Pipe Coupling. Edmund E. Clift, Philadelphia, Pa.

514,305. Electrolier. Edmund E. Clift, Philadelphia, Pa.

514,318. Electrode for Use in the Manufacture of Chlorine and Caustic Soda. James Greenwood, London, Eng.

514,325. Instrument for Measuring and Regulating Electrical Resistances. George B. Lawrason, New Orleans, La.

514,353. Trolley Wire Shield. Louis Eschner, Philadelphia, Pa.

514,361. Automatic Electric Fire Alarm. William A. Guthrie, Durham, N. C.

514,362. Fire Alarm and Sprinkler. William A. Guthrie, Durham, N. C.

514,398. Electric Signaling Apparatus for Railways. Edgar C. Wiley, Bristol, Tenn.

514,425. Electric Arc Lamp. William B. Luce, Brookline, Mass.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, FEBRUARY 24, 1894. No. 8

Electrical Effects at the Chicago Scenitorium.

It is undoubtedly a fact that electric lighting effects have been carried to a greater degree of perfection by Steele MacKaye in the new Scenitorium at Chicago than in any other theater or place of entertainment where electricity is utilized. This is true not because of the grand scale on which the performance is conducted, for the stage pictures are apt to surprise the spectator by reason of their smallness, or to the elaborate and delicate character of the apparatus used, for a trip behind the scenes reveals the rough-and-ready characteristics of hasty electrical construction, but rather to the very beautiful and realistic results which are obtained by carrying out Mr. MacKaye's ideas of the use of electricity in theatrical or semi-theatrical entertainments. Mr. MacKaye's reputation as a dramatist and inventor of stage mechanisms is widespread, and his ideas culminated in the stupendous Spectatorium project, which failed of realization, after the work of preparation was well advanced, owing to the business depression of last summer. The Spectatorium was planned as an adjunct to the World's Fair, to be the scene of the greatest spectacular production in the history of the world, and the great, gaunt, unfinished building adjoining the northern boundary of Jackson Park will be remembered by every visitor to the exposition. It was projected on a magnificent scale, and had it not been for the panic it would undoubtedly have made good Mr. MacKaye's predictions. As an evidence of the grand scale on which the enterprise was begun it may be stated that the electrical equipment alone would have cost about $75,000. The failure of the Spectatorium was a severe blow to Mr. MacKaye, and it was only after much urging that he was induced to again present his new form of entertainment, greatly reduced in size and scope, to the public in the Scenitorium. A downtown building formerly used for the exhibition of a cyclorama was leased, and the interior was entirely remodeled. The entertainment is now produced nightly and is attracting considerable attention. According to Mr. MacKaye's terminology, a scenitorium is a place where a scenitorio is produced, and the latter is defined as "a form of art combining the realism obtained by progress in scenic mechanism with music of an oratorio character." In the present nstance the scenitorio presented is entitled "The World Finder," and, as may be supposed, relates to the triumphs and sufferings of Columbus. The story is presented by a series of stage pictures, sometimes distinct from one another and sometimes merging together, and the ideal significance of the situations portrayed to the eye is made manifest to the ear by an unseen chorus and orchestra. There is no acting whatever, and the only spoken words are those of Mr. MacKaye (now, unfortunately, debarred from this position by reason of severe illness), who reads a lecture describing the incidents connected with the scenes presented and explaining the meaning of the music. "The World Finder" is a rather somber production, as is, perhaps, befitting, and it differs radically from all other forms of theatrical entertainment. Whether it will suit the popular taste is a problem remaining to be solved, but that it is an artistic success there can be no question.

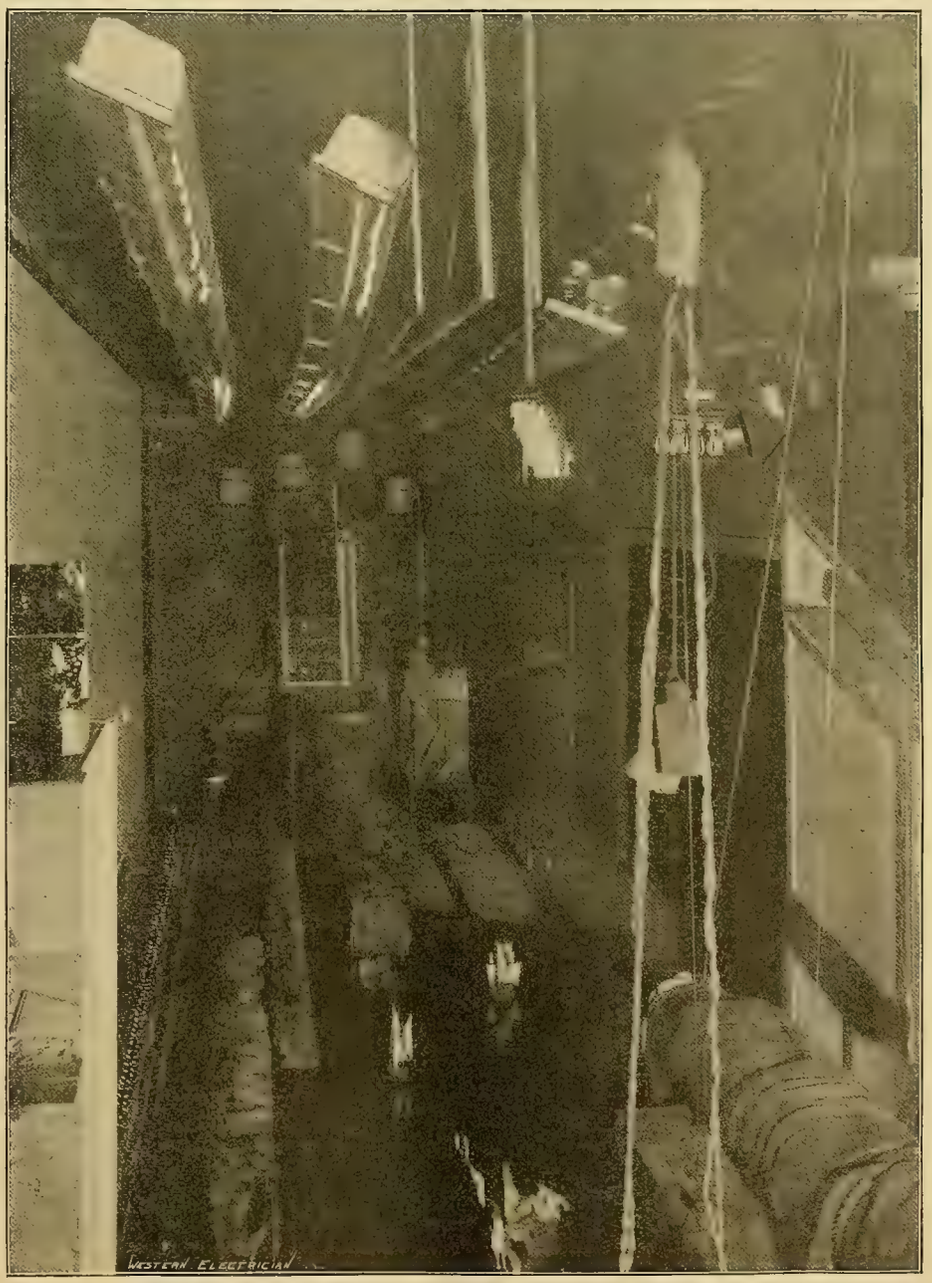


FIG. 1. ELECTRICAL EFFECTS AT THE CHICAGO SCENITORIUM.—ELECTRICAL AND MECHANICAL STAGE APPARATUS.

As before stated, the stage pictures are comparatively small, being framed in an opening 18 feet wide and 10 feet high. Before they are presented the auditorium is completely darkened, and the scenes are illuminated entirely by the light of incandescent lamps arranged about the stage. On this illumination the success of the production largely depends, and it is wonderfully realistic. Dawn, sunrise, the glare of noonday, sunset, the gathering dusk, moonlight, starlight, the darkening storm, the gleam of lightning and the reassuring rainbow, with many other details of light and shade, are all represented with almost absolute fidelity to nature. Visitors to the World's Fair will be reminded, to some extent, of the electric scenic theaters there exhibited, but the Scenitorium effects are much more elaborate and varied. Moreover, as Mr. MacKaye's model of the Spectatorium was on view in Chicago long before the fair opened, the projector can hardly be charged with plagiarism.

An astonishing variety of mechanical and electrical apparatus, much of it of Mr. MacKaye's invention, is necessary on the stage to produce the scenes witnessed by the spectators. As the story of Columbus is essentially that of a voyage, water plays a prominent part, and the three little caravels seem to traverse many miles, the effect being gained by moving the scenery behind them. There is no deception about the water, which is contained in a tank and is 18 inches deep. A view of a portion of the stage mechanism is shown in Fig. 1. The scenery is mounted on wrought iron latticed cars running in the water and of course invisible to the spectators. A certain set of these cars, placed in a definite relative position to one another, constitutes a picture of one of the scenes. These cars are handled by a system of cables, which are operated by friction clutches and levers. The shafts upon which these clutches are mounted are driven by a small vertical engine of about 6 horse power. An open and a crossed belt running to two separate friction clutch pulleys on the main shaft give to this shaft two directions of rotation. A system of clutch gears enables the operator to run this main shaft at two speeds, relatively slow and fast. The operator then, with a further system of levers and clutches, has full control of the scenic cars, and at will he can handle them in groups, or separately, as the case may be. The wind effect is produced by an electric motor and 30-inch blower placed on the roof of the building. These force a strong current of air through a pipe with a flexible end, shown in the lower right-hand corner of Fig 1, by which the sails of the ships are filled.

In the whole Scenitorium there are about 1,100 incandescent lamps—800 on the stage and 300 in the auditorium, foyer and offices—ranging from miniature lamps of one candle power to three powerful lights, said to be of 500 candle power each. Current is obtained from an isolated plant consisting of an Excelsior boiler, an Excelsior engine

with a cylinder 10 inches in diameter and 15 inches stroke and an old 110 volt Muncie dynamo of the style employing but one field magnet, from which as many as 600 lights have been operated, although rated much lower. On the stage the clear and colored lamps are everywhere—in borders overhead, in "horizon lights" beneath, back of the scenery on the stages for "atmospheric lighting," in the "sun" and the "moon," in the wings at the sides, in special reflectors and in a dozen other places. There is a switchboard in the engine room, but all the stage lighting is controlled with the greatest nicety from the cylindrical switchboard and rheostat arrangement shown in part in Fig. 2. The cylindrical shape was adopted to bring the greatest possible number of switches and levers within the reach of the operator. The switchboard apparatus, or "transmitter," as Mr. MacKaye calls it, is the center of the whole electrical system. Stationed within it the electrician regulates all of the beautiful light effects which delight the spectators in the darkened auditorium. The circuit switches and fuse blocks are on the upper portion, while 25 large rheostats, wound for varying carrying capacities, are placed below. The rheostats are all cylindrical, with the coils of wire on the outside and exterior contact points. The latter travel up and down and are operated by a three horse power motor, through the medium of a worm screw and a system of varying friction pulleys of small size. The operator controls the motion of the contact points on the rheostats by levers, several of which are shown at the bottom of Fig. 2, directly over the rheostats. He can put into action any one or any combination of rheostats, and vary the intensity or color of the light as he desires.

A number of special electrical features add greatly to the effectiveness of the results obtained. Among these the "rising, traveling and setting sun and moon" are prominent. These celestial bodies are made up of clusters of incandescent lamps, those of the sun of clear glass, while the moon lamps are blue. Both are shown in Fig. 1, the sun being particularly prominent. The miniature orb of day is made up of 90 fifty candle power lamps wired closely together on a fireproof wooden base, which is suspended from a curved overhead tramway operated by a wire rope. The sun cluster is adapted to be raised or lowered from the track on which it is suspended, and the lamps are fed by means of a trolley contact. Two color-boxes are provided, one on either side of the stage, as shown in the picture, and the colors of sunrise and sunset are produced by slowly raising or lowering the "sun" out of or into one of these boxes, the gelatine slides of which are arranged to produce the natural transition of colors. The light from this aggregation of high candle power lamps is a powerful one, and as the overhead cluster slowly travels from the "east" of the scene to the "west" the shadows are naturally cast, and the effect is very realistic. The lamps are connected with a rheositat in the "transmitter" and are readily dimmed to represent the approach of a storm. When the sun bursts out again the shadows show that it has traveled a due proportion of its course toward the west during its temporary eclipse. The "moon" is managed on a similar but separate track, but is of course much smaller, consisting of 10 fifty candle power lamps.

An interesting feature is the rainbow which is shown after the storm. This effect is produced by the light from an arc lamp burned on an incandescent circuit, which is thrown through a semi-circular glass prism nicely adjusted to produce the desired image on the drop scene representing the clearing rain-clouds. By careful manipulation the delicately tinted arch is seen to grow to its full beauty and die out as in nature. The lightning flashes during the storm are produced by the simple process of short-circuiting an electrical circuit by means of two carbons manipulated by the operator. The thunder results from the striking of a number of projections in a hollow box by a series of "paddles," the imitation being very good.

In the course of the production of "The World Finder" Columbus sees two visions. These are painted on drop scenes and it is necessary to bring out the figures from obscurity to greater and greater brightness until the climax is reached. This is accomplished without graduating the general stage illumination by a special "vision reflector" arranged, as shown on the right in Fig. 1, over the stage opening and directed back toward the scene to be illumined. In this reflector are three incandescent lamps of exceptionally large size, said to be of 500 candle power each. These are connected with the "transmitter," and at the proper time are very gradually brought up to full candle power, bringing out the figures in the vision with beautiful distinctness.

The most remarkable feature of the Scenitorium is the arrangement adopted for screening the stage from the view of the spectators between the scenes and without closing the opening. This is one of Mr. MacKaye's inventions, and he styles it the luxauleator or curtain of light. The device is simplicity itself, but the results obtained are astonishingly effective. "The World Finder" is divided into two acts, and the sliding doors in the stage opening are only closed at the end of each act. At all other times the different scenes are arranged behind the intangible yet impenetrable screen of the curtain of light. The auditorium is dark from end to end of each act. At the end of each scene, by one movement of a double throw switch, the bulk of the stage lighting is cut off and the luxauleator is thrown on. The latter consists simply of 46 incandescent lamps of 16 candle power each, arranged about the stage opening in the manner shown in Fig. 3. The lamps are placed in conical reflectors of nickeled tin, and the angle of reflection is such that the eye is unable

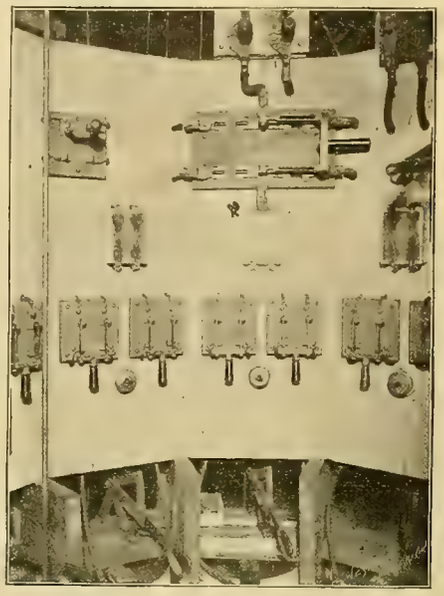


FIG. 2. ELECTRICAL EFFECTS AT THE CHICAGO SCENITORIUM.—ARRANGEMENT OF SWITCHES AND RHEOSTATS.

to penetrate beyond the sheet of light thus thrown in the faces of the spectators, notwithstanding the fact that sufficient light is left on the stage to enable the workmen to make the necessary changes with ease. In Fig. 3 is shown the exact appearance of the proscenium when the luxauleator is on, although there is considerable light back of it. The contrast between the brilliant lighting of the stage and the midnight darkness of the opening that succeeds it is startling and curious, and excites much comment. One may advance within a foot of the curtain of light and still be unable to see through it. If the investigator sticks his head through the opening, however, everything on the stage is visible. From the stage side of the curtain the auditorium is seen to be well lighted by the luxauleator lamps. When the device was first put in operation it was found that the reflected light was too powerful for the eyes of the spectators, having a dazzling effect, and the lamps are now run considerably below candle power.

There are many other interesting details in the electrical equipment of the Scenitorium, such as the miniature lamps in the various structures on the stage, the colored "horizon lights," the general atmospheric lighting effects, the "constellation" and so on. Of the stage pictures themselves two reproductions are shown in Figs. 4 and 5. The former represents the departure from Palos and the latter the arrival at San Salvador. Both are represented as flooded by the noonday sun. Fig. 4 is of particular interest, as the photograph was made entirely by the incandescent light of the scene, with 30 minutes' exposure. All who have attempted to secure photographs by incandescent light will recognize the power and even distribution of the light by which this feat was rendered possible. The photograph for Fig. 5 was taken partly by incandescent and partly by flash-light. The pictures give only a faint idea, however, of the beauty of the scenes. The credit for the result is of course mainly due to Mr. MacKaye, but it would be unjust to omit mention of Edward Puchta, M. E., and D. J. Buckley, in charge of the mechanical and electrical departments respectively, who, by their skill and energy, have contributed largely to the success of the production.

FIG. 4. ELECTRICAL EFFECTS AT THE CHICAGO SCENITORIUM.—STAGE PICTURE REPRESENTING COLUMBUS' DEPARTURE FROM PALOS.

National Electric Light Association.

Preparations for the annual convention of the National Electric Light association are about completed, and the committees in charge report the outlook to be very favorable for a largely attended meeting. The headquarters for the convention will be at the Ebbitt House, which is centrally located and well adapted to the purposes of the convention. Following is the programme arranged by the committee:

Tuesday, February 27th.

Meeting of the executive committee at 9 A. M., Parlor 36, Ebbitt House.

Morning session, 10:30 o'clock—Grand Army Hall. Address: President E. A. Armstrong. Reports of committees: Legislation, C. H. Wilmerding; World's Fair, B. E. Sunny; Relation between Manufacturing and Central Station Companies, F. Nicholls.

Afternoon session, 2 o'clock—Reports of committees. Data, H. M. Swetland; Finance, John A. Seely; Underground Conduits and Conductors, M. J. Francisco; Rules for Safe Wiring, William J. Hammer; Paper by E. A. Leslie: "Impressions of a Central Station Man Abroad."

Wednesday, February 28th.

Morning session, 10 o'clock—Paper by J. H. Vail: "The Importance of Complete Metallic Circuits for Electric Railways." General discussion of the topics, Electrolytical Effects of Return Currents and Storage Batteries.

Afternoon session, 2:30 o'clock—Paper by A. B. Herrick, "Development of Switchboards for Modern Central Stations." General discussion of the topics, What is the most Economical Size for Arc Dynamos? Charles R. Huntley, George A. Redman, E. F. Peck, G. H. Blaxter, H. H. Fairbanks; Underground Circuits—George W. Plympton, H. J. Smith, C. H. Wilmerding, M. J. Francisco, John A. Seely; How to Rate Arc Lamps—James I. Ayer, C. F. Hesser, A. J. De Camp, E. W. Rollins, George R. Stetson, M. A. Beal.

Evening session, 8 o'clock—Paper by T. C. Martin and L. Stieringer: "Electric Lighting at the World's Fair and Some of its Lessons," Illustrated with Stereopticon.

Thursday, March 1st.

Morning session, 10 o'clock—Paper by Charles F. Scott: "Polyphase Transmission." General discussion of the topics, Arc Lights on Incandescent Circuits, C. L. Edgar, L. B. Marks, J. T. Ridgway, W. S. Barstow, Thomas Spencer, Jno. C. Knight, Frederic Nicholls; Meters vs. Flat Rates, Charles E. Scott, J. D. Barth, W. J. Greene, J. J. Burleigh, J. Gynne, J. J. Moore; The Alternating Motor; Nikola, Tesla and others.

Afternoon session, 2:30 o'clock—Executive session. Reports of secretary and treasurer and executive committee. Election of officers.

The eastern delegation will reach Washington Monday evening by special train. Chicago, St. Louis and Cincinnati members will reach the convention city shortly after noon on Monday. Arrangements have been made with the B. & O. and the Big Four companies for special accommodations, a rate of a fare and a third having been secured. The interest that Washington has for everybody interested in electrical work will undoubtedly assist in making the attendance large and representative.

The Goebel Claim.

The question, Did Henry Goebel make a working incandescent lamp prior to Edison? appears to be "one of those things that no fellow can find out" with certainty. The conflicting claims on this point were considered at some length in a biographical sketch published in the WESTERN ELECTRICIAN of December 16th last, and now A. M. Tanner presents himself with an article in the *Electrical Review* of London, in which he intimates very strongly that the whole story was a fabrication and seems to show that in Germany, at least, Goebel's electrical achievements may be reckoned as a minus quantity. Of course it is possible that Goebel might have told the truth about his American experiences while drawing on his imagination for his trans-Atlantic exploits, but this will be regarded as doubtful. At any rate Mr. Tanner's article throws an interesting light on the question. Following is an extract:

In order to establish the truth or falsity of the Goebel story, so far as it relates to experiments in electric lighting having been made in Hanover in the 40's, upon the instigation of a Prof. Moenighausen or Munchhausen, the writer presented himself at the Technische Hochschule in the city of Hanover, and was courteously received there by Prof. Christian Moritz Rühlmann, who has held a professorship chair at this institution continuously since the year 1840.

Prof. Rühlmann, a well-preserved old gentleman, evidently knew whereof he was speaking when he remarked that no person by the name of Moenighausen or Munchhausen was ever known as a "professor" in the kingdom of Hanover, and that very few persons cared, illegally, to bear this prefix to their name since it might land them in prison. As to a Moenighausen or Munchhausen having experimented with electric lighting at Hanover in the 40's, he never heard of anything in this line, and did not think it probable that if such experiments had really taken place they would have escaped his attention.

Professor Rühlmann seemed to be amused at the credulity of the Americans in placing complicated electrical experiments in Hanoverian villages at a time when electricity was solely employed for telegraphic purposes, and this only about the year 1844, when the first railway in Hanover was inaugurated. This was the line from Hanover to Brunswick.

Where, in the early 40's, could this Moenighausen or Goebel have obtained their electrical supplies for arc and incandescent lighting experiments? Certainly not in Hanover, was forcibly presented by Professor Rühlmann. When his attention was drawn to the statement that Moenighausen or Goebel alleged that they were aware of the Starr-King experiments in England, Professor Rühlmann simply referred the writer to the extensive library of the Technische Hochschule to find therein any book or journal which would have enabled any one from the years 1846 to 1848, inclusive, to obtain a description of the experiments carried out at the Royal Institute at London, late in the year 1845. A most careful research failed to disclose any book or journal existant in the 40's which could have reached Goebel or his alleged professor friend, and enabled them to study and continue the Starr-King experiments.

As a matter of fact, the early history of electric lighting was only carefully investigated when the modern filament lamp came into existence, and only then was it ascertained what Starr and King really did late in 1845 or early in 1846.

How then was it possible for a person residing at a small town, some thirty miles from Hanover, to obtain knowledge direct from England concerning experiments about which there was no published information accessible to the professors of the Technische Hochschule?

Springe, the birthplace and home of Goebel up to the date of his emigration in the year 1848, was not within easy reaching distance from Hanover at a time when news traveled slowly and electrical experiments were seldom performed, except in the laboratories of scientific and educational institutions.

Visit Springe, remarked Professor Rühlmann, and you will probably learn that Goebel evolved all his alleged electrical experiments out of his inner consciousness, and that they have no foundation in fact.

An hour's ride by railway brought the writer to Springe, and there, in this village of rural Hanover, friends and comrades of Henry Goebel were soon found. One, a hale and hearty old man, now serving as court bailiff at Springe, and born in the year 1816, told the writer that Heinrich Goebel never attended the Technische Hochschule at Hanover, and that he was a permanent resident of Springe up to the date of his departure for America. He was no watchmaker or optician, and was engaged chiefly in going round from place to place selling and repairing clocks. Before that time he had been a locksmith.

When asked to be guided to the little shop where Professor Moenighausen was in the habit of spending his leisure time to make electrical experiments this ancient court bailiff said that he had never heard of such a professor, or any person bearing such a name, and that Heinrich Goebel, after he left his father's house, lived in a little cottage to which the writer was led.

This cottage is a one-story dwelling, having a gable roof with a garret, and one living room on the ground floor. It is difficult to imagine, being in this room having only two small square windows, that perverted or hastily written history was inclined to place complicated electrical experiments within these dingy surroundings.

Heinrich Goebel's boyhood friends being questioned, one said that he remembered that Goebel made a torch of coal put in a clay tube, but that it was lighted at the end by a flame, and that there was no electricity about it.

It seemed rather remarkable that Goebel ever made the allegation that he built magneto-electric machines in his cottage at Springe. None of his neighbors and friends ever heard of such a thing, and most assuredly had he ever carried on any electrical experiments at Springe, his work would not have remained unknown. A village in rural Hanover is not like the great city of New York, where, as the *Electric Power* appropriately says: "Goebel arrived in New York in 1849, and from that time on his work is wrapped in mystery." Goebel came of a peasant stock, and his father never was consul of the Netherlands at New York, since he was a gardener by profession. Certainly the work of Goebel at Springe was no mystery to his friends and neighbors, and no trace can be found of his alleged professor friend and tutor—Moenighausen or Munchhausen as the name has been indifferently written.

Was this professor friend another Mrs. Harris, and is the whole thing another Munchhausen story?

Wisconsin Electric Club.

C. R. Gillman, electrician for the Chicago, Milwaukee & St. Paul Railway company, read a paper before the Wisconsin Electric club on February 16th on "Electric Lighting of

FIG. 3. ELECTRICAL EFFECTS AT THE CHICAGO SCENITORIUM.—THE LUXAULEATOR.

Trains as Applied to the Chicago, Milwaukee & St. Paul Railway System." Mr. Gillman showed the different operating costs of the storage battery and the direct connected systems. The storage battery system was the first system applied (1889) and the direct connected system is the one now in use. After a thorough trial of the storage battery system it was thrown out and the present system adopted with more satisfactory results. The present system is operated from a car especially adapted for the purpose of heating and lighting the train. The boiler, dynamo, coal bunkers, etc,, are in one end of the car and the balance of the car is utilized as a buffet car.

Mr. Gillman acknowledged that the present system was still costly and that there was room for improvement. He thought that the storage battery system would be the final solution of train lighting when a battery could be found that could stand the jar of moving trains and still keep up under all circumstances.

The next meeting of the club will be held at the new club rooms in the Goldsmith building on March 2d. The *Sentinel* company has invited the club to inspect the electrical machinery, etc., in its new building under the guidance of James Bradshaw, the mechanical engineer who designed the entire mechanical and electrical plant in the building.

Waddell-Entz Company.

Judge Wheeler of the Superior Court, in pursuance of a request of the Waddell-Entz company, Bridgeport, Conn., has appointed Montgomery Waddell temporary receiver of the company. Mr. Waddell will continue the business of the company as before. This company is well and favorably known from its production of directly connected machinery for electric lighting work.

Projected Ocean Cables.

Some thousands of miles were added last year to the world's submarine cables, and this year may be one of the most noteworthy in the history of submarine telegraphing, says the New York *Sun*. The Anglo-American Cable company will lay a new Atlantic cable this spring. The cable is now making in England, and it is to differ in at least one striking peculiarity from all other submarine cables. Its copper conducting wire will weigh 650 pounds per knot. Hitherto no cable has had a conductor weighing so much as 500 pounds per knot, and most of the Atlantic cables have conductors weighing 400 pounds or less per knot. Many short cables, and even some long ones in tropical waters, have cores weighing as little as 107 pounds. Cables 1,900 miles long on the east coast of Africa have cores weighing 250 pounds to the knot. The heaviest core is that of the French cable from St. Pierre Miquelon to Brest. It is 2,242 miles long and weighs 485 pounds per knot.

The estimated cost for making and laying long cables is about $1,200 per knot. It is supposed that the cost of the proposed Pacific cable will be somewhat greater, because it must be laid at so great a distance from any point where the cable itself is likely to be manufactured. The total length of that cable, exclusive of 740 knots already laid in Australasian waters, will be about 5,900 knots, if San Francisco shall be the terminus in this country, and some hundreds of miles longer should Vancouver be the terminus. The cost at $1,200 per knot would be about $6,200,000 for cable and laying alone.

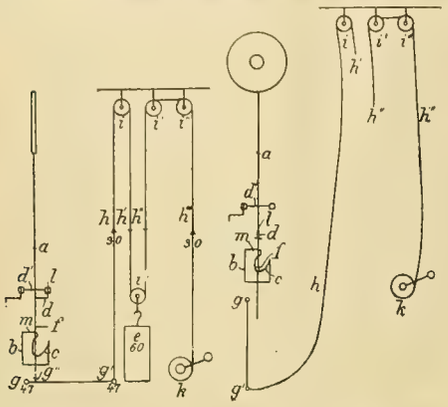
The estimated price of $1,200 per knot for making and laying cables includes everything that the contractor is usually required to do. The specifications included in the contract for the making and laying of a great cable enter into elaborate minutiæ touching what is required on both sides. There are stipulations as to the weight and quality of everything that enters into the cable. Then the number of tons' strain that the cable must be capable of enduring, the method of making joints and of testing them, and the method of indicating the length of the cable at given points are all set down in the specifications. The engineers of the company are to have the right while the cable is laying to communicate with the shore end from time to time. Cables are usually paid for in installments as so much of the cable is manufactured. The contractor is commonly required to insure the cable in transit from loss or damage by fire or sea. In the case of one important cable it was stipulated that the contractors might ship at their own risk such lengths of cable as they thought fit beyond the specified lengths, and that should any such extra cable be laid with the consent of the company's engineers, it should be paid for at the rate of £220 per knot up to £20,000. The contractor's ship usually lies at hand for some weeks after the cable is laid in order to make needed repairs while the tests are in progress. The contractor must land the cable and carry it underground to a point at a safe distance beyond high tide.

When cables were first laid it was a difficult matter to find a manufacturer to make them. The field was a new one, and all the conditions were strange. In less than forty years, however, the making of submarine cables has been brought to a wonderful degree of perfection, though that dream of the electrician, a cable that shall carry the human voice from America to Europe, has not yet been attained. There are now, however, more than forty manufacturers of cables and about two score vessels especially constructed for cable laying. Most of the factories are in Great Britain, but the cable ships are scattered over the globe. Three are regularly stationed at Halifax, seven at London, four at Silvertown, two at Singapore, two in the West Indies, two at Callao, three in the Mediterranean, one at Gibraltar, one at Aden, one at Shanghai, one at Copenhagen, one at Brest, one at Pernambuco and one at Montevideo, with others at points in China, India and Australia. They are held in readiness to go to any point within their jurisdiction for repairs upon telegraphic notice.

The world is now so netted with cables, great and small, and new ones are laid so frequently, that there is much demand for the services of the cable-laying ships. A list of the world's cables, long and short, set down in tabulated form, occupies twenty large and closely printed pages. The cable map of the world, prepared by th

FIG. 5. ELECTRICAL EFFECTS AT THE CHICAGO SCENITORIUM.—STAGE PICTURE REPRESENTING COLUMBUS' ARRIVAL AT SAN SALVADOR.

United States Navy Department, shows that the Mediterranean is thickly netted with cables west of Malta. So is the North Atlantic, between the thirty-eighth and fifty-fifth parallels. The North Sea, the Red Sea and the Arabian Sea have many cables. The only great unbridged spaces now are the Pacific, the South Atlantic and the great stretch of the Indian Ocean between Madagascar and Australia. There is no considerable cable north of Stockholm or south of Nelson, New Zealand. The Black Sea is completely girdled by land lines and crossed by one cable. The Gulf of Mexico is crossed, though not at its widest, by several cables, and the waters of the West Indies are becoming thickly netted with short cables. Coast communications in the United States and Europe are maintained mainly by land lines, but in Africa, South America and much of Asia the same thing is attained by means of long or short cable loops. It thus happens that this country, although more thoroughly equipped with telegraph lines than any other in the world, has a comparatively small amount of cable within her own waters. This may, perhaps, account in part for the fact that cable making is only just beginning to be an important industry in the United States.



FIGS. 1 AND 2. AUSTRIAN ELECTRICAL RAILROAD SIGNAL.

The navy of the United States, however, has done a vast deal for the art of cable laying. Commander Sigsbee has invented a highly effective sounding machine for ascertaining the depth of the ocean, an absolutely necessary preliminary to cable laying. Lieutenant-Commander Z. L. Tanner of the navy has devised an ingenious case for deep-sea thermometers and also improved a thermometer frame invented by an Italian naval officer. The Navy Mepartment has also issued an elaborate treatise on cable laying and made soundings for the proposed Pacific cable route.

Austrian Electrical Railroad Signal.

According to a universally recognized principle, a railroad signal should, by any disturbance on the road, automatically set itself at "Stop—Danger!" To meet this condition various so-called distance danger signals have been devised, having an electric relay releasing a weight attached to the operating mechanism. These have only imperfectly accomplished their object, and some of them not at all.

Anton Tierich of Vienna announces, however, that he has succeeded in designing an arrangement which has done away with a further objection to electrical operation—a device that, in case of a break in the rope supporting the weight, will automatically set the signal at "Stop" and cause it to remain there. The principle underlying the arrangement is as follows:

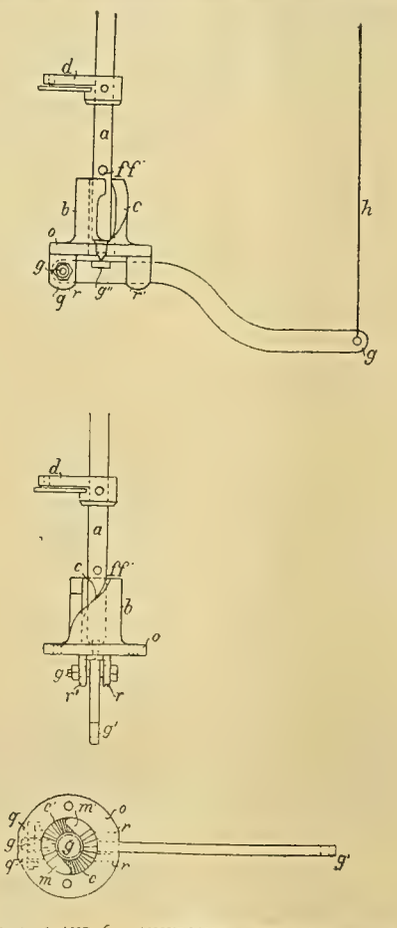
The shaft a of the signal screen, Figs. 1 and 2, passes through a hollow cylinder on which are two spiral planes $c\,c_1$ diametrically opposite each other. For the sake of clearness only one plane is shown in the accompanying figures, except in Fig. 6. On the shaft a, beside the finger d, through which the force of weight is communicated to the shaft, is the stud $f f_1$, Fig. 4. The lower end of the signal shaft rests on a lever which is easily movable at g, about a horizontal axis and which, on the other end, as at g_1 is connected to the end of the weight cord $h_1\,h_2\,h_3$, which, passing over the fixed pulleys, $i\,i_1\,i_2$ and the loose pulley i_3, leads to the drum of the actuating mechanism. As long as the weight rope remains intact the lever $g\,g_1$ will remain in a horizontal position, Fig. 1. As the ratio of the two lever arms, $g\,g_1$ and gg_2 is 1 to 8, the force of the weight e (30 kilogrammes) upward is nearly six times as great as the weight of the body of the signal is downward. If now the weight cord should be broken, the force of the weight e ceases to work, and the lever $g\,g_1$ acting under the pressure of the signal and of its own weight, falls down, Fig. 2, thus drawing for a short distance the remainder of the weight rope. With the lever $g\,g_1$ the signal begins to fall. Assuming that it was in a "Go Ahead" position, or on its way between a "Go Ahead" and "Stop" this motion of the signal is at first only vertical and actuates the trigger from the actuating mechanicism, by drawing the bolt l out of a corresponding hole in d. At the moment of the uccoupling of the signal the stud $f\,f_1$ strikes the surface c or c_1, slides on this and thus turns the shaft 90°, showing the "Stop" signal. This is accomplished by the expenditure of a force of about 36 kilogrammes, and is thus considerably more than that with which otherwise the mechanism moves the signal.

The greatest pressure of the wind on the screen would not work to produce any equilibrium and thus turn the slanting surface back, so that the signal would show "Go Ahead" again.

The action is quite different when, at the moment of the rupture of the cord, the signal is at "Stop." In this case the stud f_1 is no larger on the slanting surface $c\,c_1$, but on the massive pieces $m\,m_1$ of the hollow cyclinder. As the lever $g\,g_1$ falls the stud $f\,f_1$ and the signal shaft connected with it, come down on the massive pieces and thus assume a new position. By this arrangement it cannot happen that the signal shaft become unoccupied nor that it turn.

In Fig. 3 are shown the several phases by which the whole thing is accomplished. The diagram p_1 shows the signal at "Go Ahead," connected with the actuating mechanism. The stud f is seen just a little above the curved surface c. Diagram p_2 shows it at the moment that the stud f touches c, and immediately afterward the bolt l has slid out of its socket at d_1. Diagram p_3 shows the stud f sliding along the curved surface and turning the signal through 45°. Diagram p_4 shows the stud when it is at its lowest point on the slanting surface and the signal has been turned through 90° to the "Stop" position. Diagram p_5 shows the signal turned to the "Stop" position by the breaking of the cord, the stud f simply resting on m without any uncoupling or turning of the signal body taking place. Figs. 4, 5 and 6 give details of the construction.

Figs. 7 and 8 show a complete electrical distance signal designed to show automatically the "Stop" signal on the parting of the weight rope. Fig. 7 shows it in ordinary use and Fig. 8 after the breaking of the cord, when the new attachment has done its work and the signal stands at "Stop."



FIGS. 4, 5 AND 6. AUSTRIAN ELECTRICAL RAILROAD SIGNAL.

The breaking of the weight rope does not often occur, and this danger can measurably be lessened by extreme care in the selection of the rope; but the very fact of such a possibility being at hand when the signal is in its most dangerous position, "Go Ahead," and of its remaining there, is a defect that should not be tolerated on railroad signal systems.

The device above described are in use on many roads in Austria-Hungary, Roumania and Servia. The description and cuts are from the *Elektrotechnische Zeitschrift.*

Notes of a Trip to the United States and to Chicago, 1893.

By W. H. Preece.

Part II.

The business of telephony in the United States has made gigantic strides since I visited that country in 1884. The following table will show the position of the industry then and now:

	1884	1893 (January 1st.)
Miles of wire	115,255	440,793
Miles of underground wire	Nil	91,463
Telephones in use	325,574	552,726*
Telephone subscribers	123,625	232,140
Number of connections between subscribers and exchanges	215 millions	600 millions (est.)
Telephone exchanges	1,325	1,351
Staff employed	4,762	9,970

* This is the total number of transmitters and receivers. According to our system of reckoning, where the two together are considered as one instrument, the number given should be divided by two. Thus for comparative purposes it may be said that the United States has 276,360 telephones in use.

It will be seen that there is a very small increase in the number of exchanges opened. This is owing to the fact that hitherto there has been a tendency to centralize the exchange work; and while many exchanges have been abandoned, the small increase is due to the fact that many new exchanges have been opened.

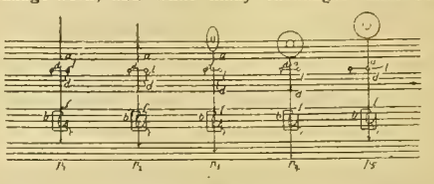


FIG. 3. AUSTRIAN ELECTRICAL RAILROAD SIGNAL.

It will also be noticed that in the States they have gone in very largely for underground work. This has been forced upon them by municipal action. In addition to this, the companies themselves have been compelled by the indifferent working of their systems to fall back upon the metallic circuit, and now there are 23,053 metallic circuits in use. In New York 62 per cent. of the circuits are metallic, in Buffalo 77,84 per cent., in Boston over 50 per cent., in Chicago 20 per cent., and in Brooklyn 60 per cent.

The business of telephony in the United States is a gigantic monopoly in the hands of the American Bell Telephone company, whose headquarters are at Boston. This company owns more than one-half the stock in every telephone company in the States. It holds itself the whole of the stock of what is commonly known as the Long-Distance Telephone company, but which is really entitled the American Telephone & Telegraph company, and thus by having control of the stock in every company it maintains the power and monopoly. The advantage of this monopoly is the establishment of a uniformity of working and practice that is highly and extremely beneficial. The form of apparatus used, the mode of working, the details of construction, and all the methods in use are dictated from Boston. The result is little or no friction; and while each independent company is self-managed and self-contained, nevertheless it is subservient to the direction and control of headquarters at Boston. There is no divided responsibility in the United States. Every town has but one system. The result is that the service is thoroughly and perfectly performed. In those parts of the country where metallic circuits have not yet been adopted there may be defects in working, but these are rapidly being removed, for the benefit derived from metallic-circuit working is being felt everywhere in the United States.

EXCHANGES.

The modes of working may be divided into three classes:

(*a*) That dealing with local subscribers alone working upon a single exchange.

(*b*) That dealing with trunk working between exchanges in one town or district.

(*c*) That dealing with long-distance speaking, such a as that between New York and Boston, New York and Philadelphia, New York and Chicago.

I visited three exchanges in Chicago, one at Buffalo, one at Boston, and three in New York, and I looked very thoroughly into the working of each system. While I did not think that any of their local working is done any better than, if as well, as the local working on our own exchange at Newcastle-on-Tyne, there is no doubt that in their trunk working, both for inter-exchange communication and for long-distance working, they are far ahead of us in England.

The prevailing switch in the United States is the multiple board, made by the Western Electric company. The largest board in the world is one which I carefully examined at the Cortlandt street central exchange in New York. It has a capacity for 6,000 subscribers; it is 263 feet long, and is divided into 40 sections. One operator handles 60 subscribers. There are 260,000 holes, or "jacks," as they are called in the States; while in fitting up this switch 780,000 soldered joints were made.

It is found in the States that multiple boards can become too large, too unwieldy, and they introduce troubles of their own that have to be remedied. These defects are aggravated when there are several exchanges in the same city. In the Chicago main exchange 25 per cent. of the business, in Harrison street exchange 94 per cent. is trunked out. The average trunking is 50 per cent. A multiple board is, therefore, useful for only 50 per cent. of the work done. It should be explained here that the term "trunk" is adopted in America to indicate connections effected between one

exchange and another within the same area. Connections between town and town are designated "long-distance" connections. The tendency is to depart from the principle of the multiple switch; and an extremely interesting experiment is being carried out simultaneously in Chicago, Buffalo and New York to determine the merits of a new system of working called the "divided board." The divided board means this: There are two boards, the one called the answering board and the other the connecting board. The answering board contains the indicators and trunks, including those to the connecting board, and all local connections are treated as trunks through the connecting board. Thus, while each operator at the answering board attends to and answers only her sixty subscribers, and is able still to control all the trunk wires, the local spring-jacks are duplicated on the

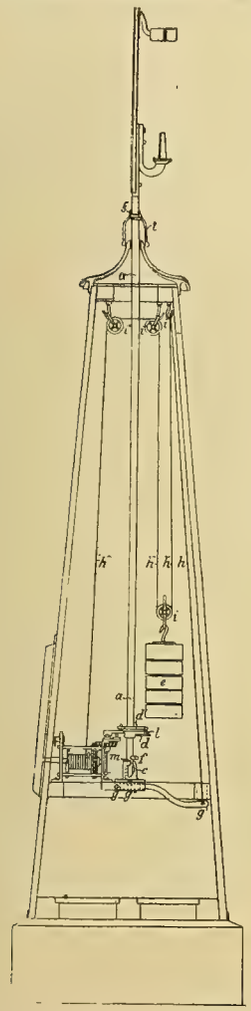


FIG. 7. AUSTRIAN ELECTRICAL RAILROAD SIGNAL.

connecting board, which may contain one, two or three complete sections, as the case may be, and are attended to by separate operators. All the business is thus trunked. The result is that the service performed for the subscribers for local connections is slightly retarded. On the other hand the work done on the trunks is equally expedited. If 50 per cent. of the work done in the central exchange is trunk work, it is argued that if subscribers find that one-half of their work is expedited and the other retarded the expediting of the more important part will compensate for the retardation of the less important, and the general result will be beneficial.

The chief merit of the divided board is that it reduces the "jacks," as the switch-holes are called. Seven sections of board with 42,000 jacks would replace 40 sections with 240,000 jacks in an exchange of 6,000 subscribers. I find opinion, however, divided upon this question; but the view is very general that when the multiple switchboard exceeds a capacity of 2,500 subscribers it certainly introduces disadvantages and defects which must in some way or other be remedied.

TRUNK WORKING.

The trunk working is wonderfully well done. In the first place the connections between the different exchanges are very numerous. In the central exchange at Chicago there are 344 outgoing and 325 incoming trunks. There are eleven exchanges, and these exchanges are located as nearly as possible in the centers of the districts which they are designed to serve. The business of these offices, however, is by no means self-contained, and a very great amount of their work is in handling calls from subscribers in one exchange to subscribers in another. These are now handled by means of 954 trunk circuits extending between the various offices; the total number outgoing from each office being as follows:

Main	344	Oakland	68
North	34	Lake View	26
South	77	Harrison	59
West	74	Wentworth	19
Canal	63	World's Fair	80
Yards	61		

In Boston, between their central station and Tremont exchange—an exchange of 833 subscribers—there are 27 outgoing and 33 incoming trunks.

The service between two exchanges is virtually a silent one. No question is asked, but instructions are given simply—"301 on North 273." This is spoken on a call circuit. The trunk operator—always a male—wears a headgear telephone, receives this instruction, and carries it out without a word being said, or a second lost.

In some places the subscriber, if he wants a subscriber on another exchange, calls his own exchange as usual, and, on getting attention, says "Tremont." He is then placed in connection with the Tremont exchange, and he himself asks for the number he wants. The former plan is, however, the more general one, and that which is preferred.

There are always so many trunk wires available that the operator has rarely to say, "Wires engaged," or "Busy," which is the common expression. I never saw one case of the kind myself. The hourly maximum number of trunk calls between Boston (main) and Tremont exchanges was:

From Boston.....557
To Boston.....475

The former averaged 20½ per circuit.
The latter averaged 14½ per circuit.

The result is that in places like Chicago, where there are 11 exchanges, and New York, where there are 9 exchanges, the trunk working is done between them virtually as though the whole of the exchanges were centered in one big hall.

The long-distance work is done in the same way. Only metallic circuits are switched on to the long-distance lines. The incoming trunk wires end in plugs, the outgoing trunk wires end in "jacks," so that when an operator hears "351 on Chicago 3," he simply takes up 351 plug and puts it in a Chicago jack without hesitation. If, however, all the Chicago trunks are busy—which he sees at once by the visual signal—he says, "Busy," and the caller has to wait his turn. In my experience this occurred but rarely. When the calls were heard the connections were made as rapidly as possible for it to be done, or as rapidly as one could wish that it should be done.

In New York the Long-distance company and the New York Telephone company are in the same building. A complete section of the New York multiple board is in the long-distance switch room, so that connections are made direct between the long distance lines and the subscribers. Usually a section of the multiple board in the local exchange is allotted for long-distance trunk work to the long distance office, which may be elsewhere. It is so arranged that when a subscriber talks on a long distance line his own circuit is entirely cut out from the local operating switch board.

There are a great many public call offices open in every city. There are 535 in New York. They call them "public pay stations." People pay tolls, and they come in and speak to the exchanges and get their connections through.

LONG-DISTANCE WORKING.

The long-distance speaking in the States is very popular and very successful. The opening of the circuit between New York and Chicago—a distance of nearly 1,000 miles—was so successful that they immediately found it necessary to erect two more circuits. There are now, therefore, three circuits between these two places. I tested these circuits, and found the working remarkably good. It was difficult to say that it was better or worse than the working of our London-Paris line.

The tariff for the long-distance work is based upon one cent per mile for five minutes' talk. The greatest distance that I found upon which speech was conducted was between Milwaukee and Portland, and between these places talking costs eleven dollars (44s.) per five minutes.

RATE OF WORKING.

I found that the customers dealt with by each operator varied very much in different towns. The following table will show this:

Town.	Customers per Operator.	
	Local.	Long-distance Trunk.
Theoretical	100	6
Chicago	66	6
Buffalo	100	..*
Boston	70	3
New York, 18th street	50	6
Brooklyn	66	10
New York, Cortlandt street	60	..*

*I did not record the number in these two exchanges.

The daily calls per circuit also vary very much. The average per day over the whole country is 8.03. At Chicago on one exchange it reaches to as many as 24.3; the mean for the whole town in January was 13.6, while in July it was 12.3. At Buffalo the mean is 6. It is interesting to note that the number at Buffalo is just the same as it was when I visited that place in 1884. At Boston the average number then was 5; it is now 12.6.

While this average of 12 or 13 calls per day is not an extraordinary one, it represents great extremes in the use of telephones, which bring about complications which are at times difficult to meet. There are in the main exchange at Chicago at the present time several hundred telephones which are used more than 109 times each day. Nearly all this business is handled between the hours of 9 A. M. and 5 P. M. During the busiest hours of the day these instruments are in use almost continually. When calls are made for them, therefore, the only reply is that they are busy. As an example of this excessive use my attention was called to the case of the Waukesha Hygeia Mineral Springs company telephone No. 929 South. A complaint was made by one of their branch offices that they could not reach the main office, the line always being reported to be busy. A record was made of the calls handled on this telephone, and in one day it was found to be used a total of 449 times, there having been 18 originating calls and 431 calls received. In one hour the telephone was used 51 times. This is perhaps the busiest line of which there is a record. Telephones used by railway offices, wholesale houses of all kinds, hotels and many other places, are apparently in use almost continuously in the busy hours of the day. Many such establishments have more than one telephone, some of them having as many as six.

The subscribers per exchange in the exchanges that I visited are as follows:

Chicago .....10,312, divided thus:—

Main	4,912	Oakland	655
South	1,037	Lake View	244
North	996	Wentworth	46
West	903	World's Fair	269
Canal	434	Harrison	424
Yards	392		

New York, Cortlandt Street 4,500
Boston, Central.....3,545

The total subscribers in New York are 9,574, at Brooklyn 4,800, and in New Jersey towns within a radius of 33 miles of New York city hall, 4,900, making a total for New York and district of 19,274.

UNDERGROUND WORK.

The statistics that I have given show how rapidly underground cables have come into use in the States. At the Chicago central exchange 76 cables, each containing 100 wires, enter the building and ascend up a shoot to the exchange room. The conductor used is smaller than that adopted by us. It is only No. 19 Brown & Sharpe gauge. It gives 47 ohms resistance per mile, and it has a capacity of .08 microfarad per mile. The insulation must be 500 megohms per mile at 60° F. All cables before being used are very carefully tested, not only to see that they comply with the specification as to conductivity, capacity and insulation, but also for what is called "cross talk," by means of buzzers.

There are no less than 30,000 miles of underground wire

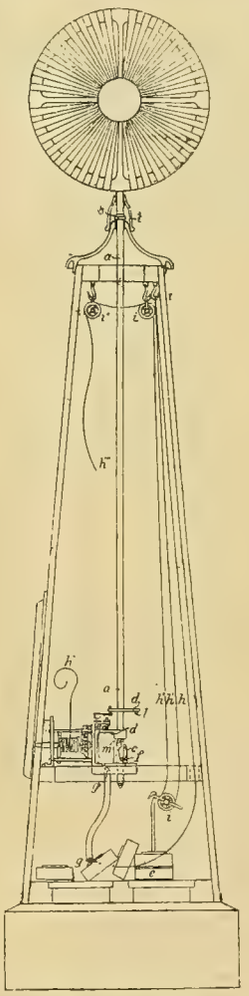


FIG. 8. AUSTRIAN ELECTRICAL RAILROAD SIGNAL.

in New York; 160 cables, each containing 100 wires, enter Cortlandt street building—that is, 16,000 wires enter this exchange. In Boston 91 lead-covered cables enter—that is, 10,920 wires in all, for each cable carries 120 wires.

The cables are made for 50, 60, or 100 pairs of wires. The 50-pair cables have a diameter of 1⅞ inches, the 60- and 100-pair cables being 2 inches and 2¼ inches in diameter respectively. These cables are in all cases brought straight to distributing boards in a room alongside the switchboard room, and here they are brought to terminals in a way similar to that adopted by us, so that changes can rapidly be made.

Subscribers' lines are so distributed among the sections of the switchboards that the work is distributed as uniformly as possible among the different operators.

The dry-core or paper insulated cable has proved to be a

[*Continued on page 91.*]

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WE have tried advertising in several electrical papers, and after discontinuing our advertisement in your journal [*Electrical World*] we advertised for a considerable period in the WESTERN ELECTRICIAN, which we found a valuable paper for reaching the West, our card in that paper bringing us many communications, a number of which resulted in sales of our alternating apparatus, including a plant for the University of Wisconsin.—*Extract from a letter of F. A. La Roche, president of the La Roche Electric Works, Philadelphia, to W. J. Johnston, publisher of the Electrical World.*

The headquarters of the WESTERN ELECTRICIAN at Washington during the convention of the National Electric Light association will be at the Ebbitt House, where representatives of this journal will be pleased to extend courtesies to members and visitors.

ANNOUNCEMENT is made of the approaching election of officers of the American Institute of Electrical Engineers at the annual meeting on May 15th. The secretary has issued a circular calling the attention of the members to the fact that a president, treasurer, three vice-presidents and four managers are to be selected. It is well that this matter is b ought thus early to the attention of members, and it is to be hoped that the nominees will be men of eminence in the profession and free from suspicion of connection with any clique in the organization. The dominant faction in the Institute will doubtless endeavor to retain control of the organization, but the best interest of the association demands a radical change in the management and policy if the Institute is to become a representative American society.

OHIO promises to lead the official fight against the Bell telephone interests. Last week a bill was introduced in the state legislature providing for municipal control of telephone exchanges. Under the terms of this measure the council of any city of the first or second class may by ordinance establish a telephone exchange and provide the necessary equipment, the city owning the entire plant. Each citizen who owns a telephone may, by complying with the rules of the council, connect with the city lines, but the city is forbidden to own any telephones except those actually used in the transaction of public business. The telephone exchange is to be controlled by a board of three trustees appointed by the council. The rental of the system is to be used first in paying the cost of the plant.

While such measures are to be expected they should not be encouraged at the expense of private enterprise. A general adoption of this policy would place the great cities of the country in little better condition than under the old arrangement. Little or no competition would be possible, and the service when controlled by politicians would probably compare unfavorably with that of the present Bell companies.

IT is encouraging to note that the prospect for the construction of the Northwestern elevated electric railway in Chicago is improving. The daily papers announce that the stock for the construction company which is to build this line has been subscribed. The proposed route has not yet been made public, and of course the right of way has yet to be secured, but the character of the men behind the enterprise is such as to warrant the statement that the accomplishment of the project is practically assured. The promoters say that the wrok of construction will be begun within sixty days. The territory which this railway will penetrate is practically unoccupied, and the projectors anticipate a hearty co-operation on the part of the property owners and residents. It is expected that the plan of construction and the system of propulsion employed in the operation of this road will resemble in general features at least the Intramural road at the World's Fair. The structure will be lighter than the Alley L, Lake street or Metropolitan, and it is believed there will be a corresponding reduction in cost. The decision of the capitalists interested to construct an elevated road to be operated electrically is certainly a marked advance in the railway field. The successful completion of the project will be a great event, and the progress of the work will be closely watched.

GEORGE W. SMALLEY, the veteran London correspondent of the *New York Tribune*, is worried because one Major Flood Page, who, it seems, occupies the imposing position of "deputy chairman of the Edison & Swan United company" in London, and is therefore "an authority in electric lighting," has contrasted the number of electrical accidents in the United States and Great Britain to show a result very unfavorable to the former. The dogmatic major goes on to say that in America, "especially in the eastern states," electrical installations are carried out with a lack of care "that would be absolutely not allowed in England," where the percentage of electrical accidents is "infinitesimal." Mr. Smalley can comfort himself by reflecting on the fact, which is evident, that Major Page does not know what he is talking about. It is undoubtedly true enough that there are more "electrical accidents" in the United States than in England, but when the relative number and size of the electrical plants in the two countries are taken into account the reason is obvious. The Chinese could undoubtedly boast that they were entirely free from troubles of this sort. Englishmen are too apt to avail themselves of the lessons taught by the pioneer electrical work in America, and then, at a late day, claim credit for superior construction in a few scattered and deliberately constructed plants. The cry is a familiar one, and it is becoming tiresome.

IN the selection of officers and the adoption of a policy for the ensuing year, the National Electric Light association should keep in mind the necessity of preserving the national character of the organization. Of late there has been a tendency to centralize the power of the association in the East, the organization at the same time looking to other sections of the country for support. While it is true that many of the large manufacturing concerns have their headquarters in the East, it should be borne in mind that the association primarily is an organization for the benefit of central station managers. As a matter of fact, the interests of the manufacturers or parent companies and the central stations are identical, yet the history of the electric lighting industry in this country shows that there have been numerous conflicts, and the managers of central stations throughout the country look with suspicion on any attempt to keep the management of the association in the East. The Washington convention should take steps toward reviving interest in the association throughout the West; otherwise it will find the Northwestern association expanding into a general western organization of the electric lighting interests. More interest was shown in the recent convention at Milwaukee than has been manifested in many years by central station managers in that territory.

THE work mapped out by the committee on programme for the convention of the National Electric Light association at Washington includes the discussion of many important subjects to central station managers and should insure a large attendance of practical men. The plan adopted by this committee differs somewhat from that followed at former meetings, in that the committee has endeavored to awaken interest in the subjects to be considered by inviting men who have made careful study of special features to present their views on these topics. Heretofore it has been customary to select several members to prepare papers upon topics assigned them and depend upon the general interest in these matters to bring out a discussion that would prove of general interest. It must be confessed that this plan has of late years failed, and that many of the best papers presented at recent conventions were read before a very small percentage of the members, while much of the time of the convention was occupied in the discussion of topics that had been worn thread bare. It is evident that this year's committee has endeavored to eliminate this feature of threshing over old straw, and in this it is to be commended. There is enough variety, too, in the subjects selected to give everybody interested in the work of the association something to consider.

All things considered, the attendance at the Washington convention should be large and throughly representative. Besides the attractive programme prepared for the meeting there is the additional reason that the members have not been called together in a year. The excuse for non-attendance that was often presented heretofore that managers of stations could not spare the time to attend two meetings each year does not now apply. There is more reason to-day for attendance at these conventions than ever before existed. The association can be made a powerful force in promoting the interests of the industry it represents if the members continue to work in harmony and keep in mind the object of the organization.

IN his address on taking the office of president of the British Institution of Electrical Engineers Alexander Siemens took occasion to admit that the use of electricity was much more common in the United States than in England, and he went on to say that this was largely due to the American idea of local government, as "the local authorities in the majority of cases have the power to make agreements with electrical companies for supplying the district with electrical energy for various purposes." He also spoke of the practice of American manufacturers in standardizing electrical machinery and supplies, saying that this made it possible to sell apparatus cheaply and was another cause of the remarkable electrical development in the United States. Mr. Siemens advanced the opinion, however, that this practice did not lead to the most economic results, and caused a quality of construction inferior to the English standard. He added: "Those of you who have visited the World's Fair at Chicago last year, and have examined a little into the details of workmanship and design, will doubtless agree that Sir Richard Webster was fully justified in his address to the Society of Arts, in contrasting the American and the English exhibits in this respect, very much in favor of the latter." Mr. Siemens was an official delegate to the World's Electrical Congress held in Chicago last August, and his opinion is of value, but he has fallen into the common English error of failing to take into account the varying conditions to be met by the American and British electrical manufacturers. The generalization is also too broad, as now-a-days no important plant is built without independent engineering advice and supervision, efficient and economic operation being carefully studied in each instance. Much work of an inferior quality was put in during the early days of the industry in the United States, but the present American construction, both in machinery and appliances for distribution and utilization, is at least equal to the best English practice, Sir Richard Webster to the contrary notwithstanding.

Notes of a Trip to the United States and to Chicago, 1893.

[*Continued from page 89.*]

very great success, and is now universally adopted for telephone purposes.

CHICAGO.

I have given the number of exchanges and subscribers in Chicago. To provide for this service there are—

Miles of conduit	48.02
Miles of duct or channel	433 24
Miles of cable, underground	106.96
Miles of wire, underground	17,995.53
Number of manholes	888.0
Miles of cable, aerial	65.97
Miles of wire in aerial cables	5,184.70
Total miles of wire in cables	23,180.23
Total miles of wire on poles	7 958.0

SWITCHBOARDS AND INDICATORS.

Great improvements in working have been made in consequence of the introduction of metallic circuits. Visual signals, like those employed by the Postoffice department, are coming in. Dirt in the gear was a great source of trouble. False busy signals were frequently received. Now a third wire and an automatic restoring indicator have made the busy test reliable. The visual signals on trunk wires are assimilating the American working to our postoffice system.

DISTURBANCES.

The disturbances in telephone circuits created by the extension of electric railways have been severely felt in many parts of the United States. We have experienced the same in London, Liverpool, Leeds and Blackpool. But owing to the prompt action taken by the telephone and railway companies, especially in Boston, the area of disturbance has been much reduced, and the influence of electric railways on telephones has ceased to be a trouble. Of course this result is very much favored by the rapid introduction of metallic circuits into cities; but it has also been favored by the prompt action of the railway companies themselves. They did all that they were asked to do, and that at once. In all cases the negative pole of the dynamo at the generating station is put to earth, and the return conductors have been enlarged. Extra copper wires have been buried between the rails, and heavier conductors have been put upon the poles. The return conductor is the largest size copper wire made, viz., No. 0. The rails have been bonded together and to this return conductor; and in Boston the rails are welded electrically, which is very effective. I was, unfortunately, unable to see this electric welding in operation, for the transformer had broken down, and was in the shops under repair. I saw the whole apparatus, however. A special car is used for the plant, and the system adopted is extremely satisfactory.

The electrolytic action of these disturbing currents has been noticed not only as affecting gas and water pipes, but also the lead coating of the telephone companies' cables. I have seen several specimens of lead pipes much pitted. I have reason to believe that the remedies adopted to cure disturbance will also put a stop to what might have become an element of great danger to underground cables.

LIGHTNING PROTECTION.

A very efficient system of lightning protection has been introduced upon the telephone system, not so much to protect the system from the effects of lightning, as from the effects of those powerful stray currents that enter a telephone circuit when accidental contacts occur between it and electric light and electric railway conductors. Such contacts have been frequent, owing to the prevalence of overhead systems, but they are diminishing now that conductors are placed underground. They have resulted in numerous accidents, and several telegraph and telephone offices have been set on fire and the apparatus destroyed. Every telephone circuit is now protected by a fuse or cut-out—a fine wire of great resistance, which melts if traversed by a powerful current; also by an air space protector on the same principle as the lightning arresters we use, but having carbon plates instead of brass plates; and, finally, by a small heat coil, which puts the currents to earth in a very ingenious way when the stray currents exceed a certain strength. These three guards have been found quite effective. No accident has occurred where they have been used.

RATES.

The rates or rentals demanded from the various subscribers differ very much in the States. At Buffalo they charge a toll rate on each talk; they do not demand an annual rental; they simply demand a minimum amount of business per annum. This rate in Buffalo is 10 cents for five minutes' talk, and they have adopted a system of charging one-fifth of this rate for each extra minute beyond the five. The rate in San Francisco is a small annual rental for each installation and 5 cents for each talk. A somewhat similar plan is in use at Milwaukee. But, with these three exceptions, the toll system has not found favor in the States, and at every other exchange an annual rental is demanded.

The American Bell Telephone company is now considering the advisability of limiting the time for talks to three minutes instead of five, of reducing the minimum toll in proportion, of making additional charges for each minute *pro rata*, and of considering a fraction of three minutes as equivalent to the whole time.

I give below, in tabular form, the rentals charged in twenty-five of the chief cities of the States:

The rates vary, and are, as will have been seen, very high; but although the enterprise is in the hands of private companies, it must be noted that they have great difficulties to contend with. In a place like New York the rents and the cost of buildings is excessive. In one small exchange they pay no less than $7,000 a year rental for one floor. Taxes everywhere are enormous. Not only are they taxed by the state, but they are taxed by the municipalities. Way-leaves are excessive. In New York alone they have to pay to the company controling the underground conduits no less than $250,000 per annum conduit rental—$25 per subscriber for underground wire rental alone. The distances, too, that they have to carry their underground system in New York, in Philadelphia, and in other places are very considerable. They have been forced by municipal action to go underground. In the face of these restrictions no comparison between rentals in New York and those paid in this country can be made. The amount of the average rental in London scarcely exceeds £15 per annum. The average amount of rental throughout the country on our post office system is £9 10s., but in New York subscribers have to pay up to £50 per annum.

STANDARD YEARLY RATES FOR SUBSCRIBERS.

	Business.		Residence.	
	Metallic Circuit	Single Wires.	Metallic Circuit	Single Wires.
New York	$240	$150	$180	$100
Chicago	175	125	125	100
Philadelphia	160	120	130	100
Brooklyn	150	.....	100	.....
St. Louis	.....	100 120	.....	60, 80 100
Boston	150 160	120	110 134	96
Baltimore	120 160	78	90 160	78
Cincinnati and Covington	125	100	100	72
San Francisco	72 90*	60 *	72 90	60
Cleveland	120	72	100	60
Buffalo	Toll †	.....	Toll	.....
New Orleans	.....	96	.....	62.50
Pittsburg	126	84	112.50	75
Washington	120 160	100	90 160	72
Detroit	.....	72	.....	50
Milwaukee	80 90‡	60	70 80	50
Newark	150	.....	100	.....
Minneapolis	120	72	100	60
Jersey City	150	.....	100	.....
Louisville	.....	72	.....	60
Kansas City	.....	72	.....	60
Omaha	.....	60	.....	60
St. Paul	120	72	100	60
Providence	120	60	100	48

* Also "toll" of five cents per conversation.
† Installation charge, $70 for first 500 messages.
‡ Rates cover installation and yearly business of 1,000 messages. Ten dollars is charged for each additional 500 messages.

NOTE.—Where two rates are given in the same column against an exchange they represent different kinds of instruments furnished. In many cases single-wire rates are no longer quoted for new subscribers.

I have drawn up, with the assistance of the American Bell Telephone company, a comparative statement showing the ratio between the subscribers and the population in 24 principal cities of the States. The details appear in the following tables:

CITY POPULATION COMPARED WITH CITY SUBSCRIBERS—COMPARATIVE STATEMENT, JANUARY 1, 1893.

Twenty-four Cities.	Population.	Subscribers in Exchange.	Average No. of Inhabitants to each Exchange Subscriber.
New York	1,515,301	9,066	167
Chicago	1,099,850	9,684	114
Philadelphia	1,046,964	3,620	289
Brooklyn	806,343	4,439	182
St. Louis	451,770	3,561	127
Boston	448,477	5,665*	79
Baltimore	434,439	2,116	205
Cincinnati and Covington	334,279	4,015	83
San Francisco	298,997	4,528	66
Cleveland	261,353	3,182	82
Buffalo	255,664	2,240	114
New Orleans	242,039	1,471	165
Pittsburg	238,617	3,254	73
Washington	230,392	1,845	125
Detroit	205,876	4,287	48
Milwaukee	204,468	2,561	80
Newark	181,830	1,094	166
Minneapolis	164,738	2,053	80
Jersey City	163,003	970	165
Louisville	161,129	2,556	63
Kansas City	157,984	2,581	61
Omaha	140,452	1,738	81
St. Paul, Branch of Minneapolis	133,156	1 521	88
Providence	132,146	2,948	45

* Does not include express subscribers. With express, 72 inhabitants.

It will be seen how very much these places vary. In Providence, for instance, with a population of 132,146, we find one subscriber to each 45 persons, while in Philadelphia there is one to every 289 only.

In ten of the principal towns of our own country the results are as follows:

	Population.	Subscribers in Exchange.	Average No. of Inhabitants to each Exchange Subscriber.
London	4,263,294	6,700	636.3
Liverpool	513,790	4,500	114.1
Manchester	510,998	2,300	222.1
Glasgow	669,959	3,200	209.0
Edinburg	261,737	900	294.2
Plymouth	85,610	300	285.3
Birmingham	483,520	1,200	402.9
Leeds	375,540	1,300	288.8
Hull	204,750	400	511.8
Newcastle	192,295	1,300	147.8

The telephone in the United States is essential to the business man, and its price is compared with that of an office boy. Labor in the States is expensive, and an office boy costs more than a telephone subscription.

The present generation in America has grown up with the telephone. It has become a factor of business, and absolutely essential to the transaction of that business. Its use has passed its climax; it has reached its normal stage. There is no touting for business; business comes. Every new office must have it. The working is excellent, and they are alive to the necessity of maintaining its efficiency at the very highest point. Education is complete, not only of the staff, but of the customer. The apparatus itself is being perfected. Uniformity of practice is being introduced under the operation of the paternal control at Boston, and the influence of technical education and of technical institutions is being felt everywhere.

I find a group of highly educated, clever young electricians being engaged and encouraged by the telephone companies. New blood is being introduced, and great zeal and activity is shown.

THE ELECTRICAL CONGRESS.

Two congresses were held in Chicago—the one, a general one, to which all electricians were invited, and the other called "the Chamber of Delegates," to which nominees from the different governments were sent. The latter was the more important of the two, but each secured considerable attention, and they were distinctly great successes.

The congress met on August 21st, at least 500 being present. Prof. von Helmholtz was appointed honorary president; Prof. Elisha Gray, chairman.

Each principal European country had a vice-president, and I had the honor of being selected to represent England.

The congress was divided into three sections—

A. Pure theory.
B. Theory and practice.
C. Pure practice.

Some excellent papers were read, and good discussions ensued.

The most prominent subjects dealt with were the transmission of power to great distances, and general preference was shown for alternating current systems. The work being done at Niagara excited general interest, and some of us visited these works afterwards, with great profit and pleasure.

Prof. Ayrton read a very able paper on the variation of arc lamps, so much used in America; while much interest was created by the reading of a paper by Prof. Silvanus Thompson on "Ocean Telephony," a possibility in the future. My paper on "Signaling Through Space" also created much interest.

Perhaps the most useful result of the congress was the bringing together of such an international mixture of electricians, making friendships, allaying jealousies, and breaking down national prejudices. Electricity is the only branch of science which has but one language, and it is now quite cosmical in its character. Congresses do infinite good in promoting friendliness among nations.

CHAMBER OF DELEGATES.

The object of this meeting was really to consummate the work begun by the British Association and by the Board of Trade, and to secure the official sanction of the United States government to the units selected and adopted in England. This was done, and the report of the Chamber gives international support to the proposed legalization of the ohm, volt, farad, ampere, watt and joule, as defined by the committee of the Board of Trade. There is no doubt that all European governments will now accept these decisions.

A new unit was adopted, viz., the "henry," a unit of induction, which was sometimes called the "quadrant," as defined in Paris in 1889, and sometimes the "secohm," as proposed in England. The acceptance of the name "henry" pleased the Americans very much, for their nationality has hitherto been unrepresented among the celebrated electricians whose names have been applied to the standards of electrical measurements. Germany, Italy, France were represented by Ohm, Volta, Coulomb and Ampere; while England absorbed no less than three, viz., Faraday, Watt and Joule. America has now her Henry, and is satisfied.

The following is the official report of the resolutions arrived at:

"*Resolved*, That the several governments represented by the delegates of this International Congress of Electricians be, and they are hereby, recommended to formally adopt as legal units of electrical measure the following: As a unit of resistance, the international ohm, which is based upon the ohm equal to 10^9 units of resistance of the C.G.S. system of electro-magnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14.4521 grammes in mass, of a constant cross-sectional area, and of the length of 106.3 centimeters.

"As a unit of current, the international ampere, which is one tenth of the unit of current of the C.G.S. system of electro-magnetic units, and which is represented sufficiently well for practical use by the unvarying current which, when passed through a solution of nitrate of silver in water, and in accordance with accompanying specifications, deposits silver at the rate of 0.001118 of a gramme per second.

"As a unit of electromotive force, the international volt, which is the electromotive force that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere, and which is represented sufficiently well for practical use by $\frac{1000}{1434}$ of the electromotive force between the poles or electrodes of the voltaic cell known as Clark's cell, at a temperature of 15° C., and prepared in the manner described in the accompanying specification.

"As a unit of quantity, the international coulomb, which is the quantity of electricity transferred by a current of one international ampere in one second.

"As a unit of capacity, the international farad, which is the capacity of a condenser charged to a potential of one international volt by one international coulomb of electricity.

"As a unit of work, the joule, which is equal to 10^7 units of work in the C.G.S. system, and which is represented sufficiently well for practical use by the energy expended in one second by an international ampere in an international ohm.

"As a unit of power, the watt, which is equal to 10^7 units of power in the C.G.S. system, and which is represented sufficiently well for practical use by the work done at the rate of one joule per second.

"As the unit of induction, the henry, which is the induc-

tion in a circuit when the electromotive force induced in this circuit is one international volt, while the inducing current varies at the rate of one ampere per second.

"The Chamber also voted that it was not wise to adopt or recommend a standard of light at the present time."

An attempt was made to introduce other units, but the feeling is pretty strong that language-framing electricians must rest on their oars for a time. New ideas and new measurements must have new terms and new names, but the general public must become more accustomed to the new language already invented before proceeding to manufacture more novelties in phraseology. The new terms are even now very difficult to explain, and still more difficult to understand. Morever, electricians themselves are not sufficiently unanimous either as to the necessity or upon the accuracy of the definitions of the new conditions, and therefore they can afford to wait for a final settlement for another congress some years hence—perhaps in Paris in 1900.

THE EXHIBITION.

Nothing grander in design or more beautiful in execution has ever been seen in this world than the group of buildings situated in Jackson Park, Chicago, and called the "World's Fair." It is a great misfortune that the world did not appreciate, nor respond to, the ambitious views of the conveners of this fair. Their conception was magnificent. Their architects, if they did not originate the plans, certainly rose to the occasion. Their builders realized their views. Every possible convenience and accommodation was provided for exhibitors, but the response was poor; and the internal management of the whole business, owing to inexperience and perhaps overweening confidence, was indifferent. The success of the undertaking hovered for some time over failure; but fine weather, patriotism, novelty, real beauty and cheap fares at last attracted crowds, which, numbering about 200,000 a day, have converted what looked like a disaster into a well deserved success. I have not much to say of the exhibition as an exhibition. It was very like its predecessors. It did not attract me; for, having taken part in nearly every exhibition for the last 15 years, I am sick of exhibitions. I devoted much attention to the electricity building, and observed there several novelties, some of which I have referred to in other parts of this report.

Gray's telautograph attracted much attention. It is an improvement on Cowper's writing telegraph. It reproduces the motion of a pen, so that while you are writing in London a phantom hand seems to guide the pen and reproduce your own writing in Nottingham. You can see the pen move, dot the i's and cross the t's. It makes corrections and erasures. It works well, but very weirdly. My writing and signature were clearly reproduced at the very first trial. But it is immature for practical trial at present. It has not reached its final stage. It is being improved every day. It is very complicated in construction, and it requires four wires to work it. The Western Union company in Chicago has established a circuit between its head office and stores department, and is giving it a good test.

The French and German administrations sent admirable and extensive displays of their historical working apparatus, with a very large staff of men to attend to them, but I am pleased to say that our postoffice exhibit proved much more attractive and interesting. It was better arranged and more complete; and our one solitary assistant, J. Chapman, won golden opinions by the admirable way in which he attended to his duties, and by the excellent verbal explanations he gave of our show.

The United States of America made no historical exhibit, but the Western Union company showed many relics and examples of Morse's early work.

The American public were surprised to find how much we in England had anticipated their work. Morse's first message, "What has God wrought?" was sent only in 1844. Our history commenced in 1837. Our jubilee was celebrated in 1887. Theirs is to be celebrated this year.

An exhibit that attracted much attention was a door which opened before you as you approached it, and closed behind you as you receded from it. This was done by a small electric motor which was set in motion when you stepped on a mat, and released when you passed through the door. It was worked with the same current that would light a glow lamp.

Both on entering the harbor of New York, and on going by steamer from Chicago to the World's Fair, channels for the passage of the steamship were clearly marked out at night by glow lamps fixed on spar buoys, and lighted up in series.

There was shown an electric selector of great merit and some originality. It was a plan by which any particular railway station could be selected and called, any particular signal cleared or put to "Danger," any office on a long circuit with several intermediate instruments selected and secured, any subscribers on a combination telephone circuit—that is, on a single circuit upon which several renters are fixed—could be called and isolated from the rest.

All the great manufacturers in the United States made large exhibits of their wares. The American Bell Telephone company, the Western Electric company, the General Electric company, the Westinghouse company, the Standard Electric company, had splendid shows, but few novelties. Their novelties have already been referred to, either under electric lighting or electric railways.

Electric lifts were on exhibition, and in use. They worked very well indeed, and are rapidly coming into general use in the States. The New Postal Telegraph building in New York is being fitted with several of these lifts, which are going to be worked very quickly indeed (600 feet a minute). They are being installed by the Sprague company.

Electric welding was shown in full operation, and attracted much attention.

Power was transmitted all over the place by currents, and whole exhibits were shown in motion by means of electric motors.

Along the machinery hall, 1,400 feet in length, an electric crane, 75 feet span, traveled, and formed an admirable point of observation for those who were allowed to travel on it. It was used in the preparation of the exhibition to lift and fix all the machinery. It lifts and moves 40 tons. It is worked by five motors. Its weight is 58 tons, and its speed was excellent.

There were large exhibits of every class of cable manufactured in the States—Waring, Okonite, Kerite, Patterson, dry-core, etc., and Felten & Guilleaume had in the German section a fine show of their own make. Sections of streets were shown, with pavement, manhole, conduits, joints, and everything complete.

England is the home of the alternator, but it has now taken firm root in America. In 1884 there was not a single one to be found in Philadelphia. Now they are everywhere, and alternate currents are being studied and developed in a way that is completely putting our experimentalists in the back row.

The paucity of real novelties, or of what are commonly known as "Yankee notions," was very marked. The necessity for such things—that is, the scarcity of labor—has apparently disappeared, and with its parent the child has languished. Moore's spark-interrupter—an automatic vibrating armature in a vacuum tube, by which glow lamps can be turned up or down without wasting energy—was described at a meeting of the electrical engineers at New York, but I did not see it at the World's Fair.

The distinguishing feature of the Chicago World's Fair was not alone its uniqueness, but its grandeur and its magnificence. It was not an exhibition of goods and manufactures in the old-world sense. No one seemed to care two straws for the mere trade exhibition *per se*; he admired the beautiful buildings, the waterways, the external attractions, and, above all, the congeries of people that assembled from all quarters of that great continent in such multitudes.

The distinguishing feature of American engineering is the great scale on which it is carried out and the rapidity of its adoption. An electric railway from Chicago to St. Louis, 250 miles long, is not a difficult engineering feat, for the country is level, but it is novel for the fact that it is projected to travel at the rate of 100 miles an hour.

There were some things in the exhibition that were extremely interesting. The first was a complete reproduction of an ancient Viking's war-ship—an open boat that would excite fear and trembling even in crossing the channel, but of a type that probably crossed the Atlantic long before the famous fleet of Columbus. These vessels—the Santa Maria, Pinta, and Nina—were also reproduced in all their dimensions, and in all their colors and fittings. The contrast between these relics of the past and the modern war-ship built, alongside the home of the British commission, Victoria House, was, to my mind, more suggestive than all the innumerable wares and appliances so freely exposed in the vast extent of covered area.

One interesting building was a kind of baby cloak room, where mothers could book their babies for the day, and who were there carefully tended, nursed, amused and fed for a very small charge. Each mother received a small brass check, which was her guarantee for the safe custody of her little beauty.

Strowger Automatic Telephone.

E. H. Scott, mayor of La Porte, Ind., has written the Strowger Automatic Telephone company, Chicago, the following communication regarding the operation of the company's exchange in that city:

My attention has just been called to an article in the WESTERN ELECTRICIAN of May 20, 1893, by W. H. Hyde, in which he says, referring to your exchange in this city:

"I understand that the system is constantly involved in mechanical troubles inherent to it, and that the projectors have had to keep an expert there all the time."

I desire to say in relation to the above that the exchange was put in here and opened to the public sixteen months ago, and that I am familiar with all that has been done in connection with it and with its operations.

I have a telephone in my business office and one at my residence, and they are used constantly, and I declare that the Strowger automatic switch is a great and desirable improvement and that it works perfectly and satisfactorily. It is so simple in its operation that little children six years old easily learn to make the calls, and have done so.

When the exchange was first started electricians were employed to erect it and put it in operation; there was some difficulty about the wiring in the start, but that was to be expected, it being the first exchange ever started with this automatic switch, but the difficulties were readily and quickly overcome.

The Wheel Manufacturing company, that I am connected with, put in a wheel welding (electrical) machine. It was the first and only one ever made. We received it on Feb. 1, 1891, and it was not until Dec. 28, 1891, that we got it working satisfactorily, and during that interval we had four different electrical experts to assist us in overcoming the difficulties we encountered in getting the machine down to a practical working basis.

If Mr. Hyde had visited this city and tested the automatic switch he would not have made the statement he did. The telephones in use here are not the best, but the automatic switch does its work perfectly, and in my judgment is one of the great improvements of the time.

A. E. Kennelly. E. J. Houston.

NEW ELECTRICAL CONCERN.

New Electrical Concern.

Announcement is made that Prof. Edwin J. Houston and A. E. Kennelly have determined to associate themselves as a firm of electrical experts, to open an office in Philadelphia and to establish a laboratory in the same city for high grade electrical work. These gentlemen will be ready to undertake special investigations in the line of physics in general as well as of electricity that may be required for the purpose of developing an invention, of perfecting processes involving physical principles, or of undertaking work in which accurate physical investigation is required.

It will be seen that the character of the work these gentlemen are ready to undertake will be of an especially valuable character, not only in the development of a patented invention, but especially in defending in the courts inventions that have been sued for infringements. It not infrequently happens that in such cases physical investigations of unquestioned accuracy are required in order to establish certain points, and it is in this field that the new firm contemplates making special efforts.

Prof. Houston has for a long time been well known in connection with his work in the courts in patent cases, but the demand on his time on the part of the Central High School of Philadelphia, with which he has been so long associated, has prevented him heretofore from giving that continuous attention to work of this character which its importance demands. Now that he has severed his connection with the school, there is no doubt that the work he

may undertake will be of even a higher grade than that already accomplished.

Mr. Kennelly, like Prof. Houston, is too well known to the electrical world to require either introduction or recommendation. His long work and extended experience in Mr. Edison's laboratory has thoroughly equipped him for work of this character, and the new firm of Houston & Kennelly will be welcomed by the fraternity generally.

As regards the prior work of these gentlemen it is hardly necessary to call attention to the fact that Prof. Houston is one of the inventors of the Thomson-Houston system of electric lighting now in general use, and is well known both in this country and abroad as an exceedingly prolific electrical writer, and moreover brings to this work an extended experience in various business directions. Mr. Kennelly is no less thoroughly trained for the important work he has thus undertaken with Prof. Houston. His

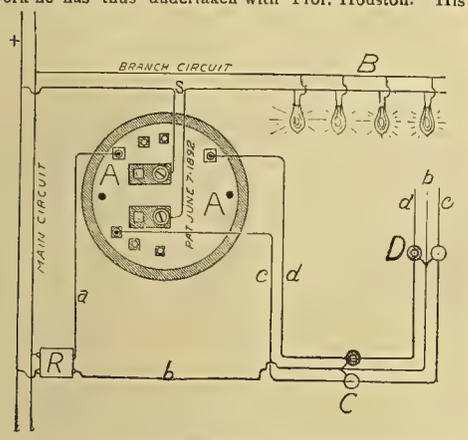


FIG. 3. IMPROVED SECHRIST AUTOMATIC SWITCH.

long experience in Mr. Edison's laboratory, where he has had charge of work of the most varied character, not only in the line of electricity, but also that of physics, makes him an exceedingly valuable member of the firm. Prof. Houston is president of the American Institute of Electrical Engineers, and Mr. Kennelly is a vice-president of that organization. Both have been actively engaged in the work of the Institute, and took a prominent part in the electrical congress at Chicago last year. Prof. Houston has also done valuable work in connection with the Franklin Institute.

Improved Sechrist Automatic Switch.

The Central Electric company of Chicago is introducing the Sechrist automatic switch, a new method of controlling electric lights. This method of electric lighting was invented by Albert Sechrist of Denver, Colo., who has purchased valuable patents covering broadly the use of the automatic switch system in the United States and several of the foreign countries. The system is especially adapted for controlling incandescent lights in private residences, and in that capacity alone gives a great range of possibilities for convenience and comfort, beside being adapted for a number of other uses, among which are the controlling of electric lights and bells for railway signaling, etc. Fig. 1 shows a six-button plate controlling three automatic switches. The metal plate, with white and black pearl buttons, is finished with an eye to attractiveness, which is one of the most important features in residence work. Instead of being collected on a metal plate, the buttons may be of small ivory or pearl and set in the casings of the doors. The automatic switch shown in Fig. 2 is located in some out-of-the-way place where it cannot be seen, as it requires no attention whatever.

By means of this system a person may have absolute control of any or all of the lights in the house from any part of the house, so that a person in moving about a

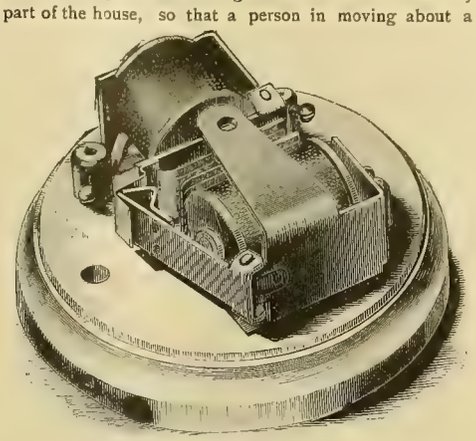


FIG. 2. IMPROVED SECHRIST AUTOMATIC SWITCH.

house in any direction is always able to turn on the light ahead and at the same time turn off the lights from that part of the house which has just been left. A person presses a button outside at night, which turns on a porch light. Immediately on opening the door, the hall, parlor, library or dining-room lights may be turned on or off. The hall lights may be turned on or off from either the first or second stories, and also from each chamber. Conveniently located beside the bed may be placed another set of buttons, and by simply touching this or that button one is enabled to turn on or off all the lights in the house. The small bell wires which run to the various push buttons may be readily attached to the doors and windows of the house, and the mere act of opening them will turn on or off the lights, or the wires may be attached to an electric mat, concealed under a rug or carpet, and the light will be automatically turned on or off as may be desired. The latter is applicable more especially as a burglar alarm.

The automatic swith itself, as shown in Fig. 2, is very simple in construction, and is simply a locking and releasing device operated by means of two electro-magnets. There are no adjusting screws or complicated parts to get out of order. The electric circuit is attached to the automatic switch the same as to any common switch, while the wires from the magnet spools, which are common bell wires, run to the different push buttons from where the switch is to be controlled. The Sechrist automatic switch may be operated with either an ordinary battery or by means of the electric light current. In using the electric light current to operate the automatic switches it is preferable to reduce the electric light current, through a resistance box, to the strength of an ordinary battery. This makes the system absolutely safe. The method of running the wires and connecting them to the automatic switch may be readily understood by referring to Fig 3. *A A* represents the back of an automatic switch, *B* a group of lights to be controlled, *S* an ordinary switch loop connected to the automatic switch; *a b* are wires supplying the reduced current to operate the automatic switch; *b c d* are ordinary bell wires which run to the different push buttons from where it is desired to control the lights; *C D* are two sets of buttons controlling the automatic switch *A A*. It is evident that any number of push buttons may be connected to the wires *b*, *c* and *d*. The Sechrist automatic switch system is said to have been successful so far as residence lighting is concerned, and to be popular wherever it has been introduced.

ELECTRIC TRACTION BY ACCUMULATORS IN PARIS.

Electric Traction by Accumulators in Paris.

The largest installation in existence for operating street cars by accumulators is said to be in Paris, where about 25 cars are now in service, a number which is soon to be increased to 70. The line is between Madeleine and St. Denis and has been in operation for over a year now. The bodies of the cars rest, with the intermedium of rollers, upon two trucks, each having one axle and being held in place by a king bolt. These two trucks are bound together by a system of joints and springs, which allows the axles to converge in curves and restores them to parallelism on straight track. A motor is attached to each axle by double reduction gear wheels, the ratio between the motor and axle being twelve to one. The gears are in an iron casing and the first pair is completely immersed in oil. The electric motors are bi-polar, of the Manchester type, with Gramme armature, series wound. The brushes are four carbon blocks. Each motor will develop, with a speed of 1,350 revolutions, a power of 10,000 watts, with a difference of potential of 200 volts. Under these conditions the efficiency between motor and axle is 73 per cent. The accumulators are of the chloride type manufactured by the Société pour le Travail Electrique des Metaux. The accumulators are placed under the seats of the car. There are one hundred and eight elements, of eleven plates each, contained in hard rubber boxes. The plates are seven and three-quarter inches by seven and three-quarter inches by quarter inch thick. The weight of an element

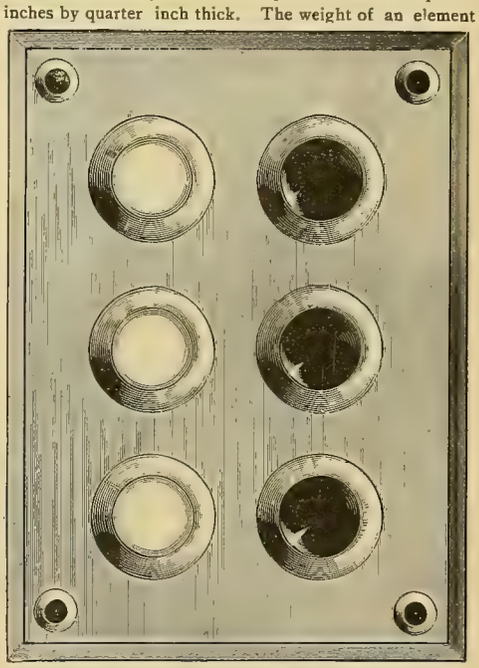


FIG. 1. IMPROVED SECHRIST AUTOMATIC SWITCH.

is thirty-eight and a half pounds. These one hundred and eight batteries are divided into twelve groups of nine batteries each, contained in twelve wooden boxes, six on each side of the car, the batteries of each group being connected in series, and the two terminals attached to copper strips fastened to one of the partitions of the wooden box. To the wooden props of the car are attached brass springs connected to the motor circuits with an intermediate regulating switch. The introduction of the boxes into the car causes these springs to slide on the copper strips and the circuit through the constituent parts of the battery is thus automatically established.

The batteries are charged on a platform made of joists, covered with tar, supported by brick piles and supplied with glass insulators. These platforms have brass contact springs like those in the cars. The batteries when placed on the platform for charging are connected in series. The station for accumulators has space for twenty-four sets of batteries, each one connected to a distributing switchboard by a special circuit, in which is an ammeter, an indicator of the direction of the current, a double-pole circuit breaker and a make-and-break switch. The transfer of the batteries between the charging tables and the cars is effected by means of small cars moving on tracks,

which run alongside of the platforms and the street car tracks. When a car returns to exchange its discharge battery for another, seven of these transfer cars are ranged on each side of the tracks; six carry boxes of accumulators freshly charged and the seventh is empty. The first box of batteries contained in the street car is slid on to the empty transfer car and is carried on it to the place which it will occupy on the charging platform. The first box of the new battery passes from its transfer car into the space in street car thus left empty, and a second box of discharged battery is removed, and so on consecutively. The platform of the transfer car can be raised and lowered by a screw and fly wheel so that it can be brought to the level of the interior of the street car or of the charging platform. This maneuver is accomplished at the most in five minutes. The charging current for the accumulators is furnished by three Desroziers dynamos. Each of them is run by a one hundred and twenty-five horse power Corliss horizontal condensing engine. Two of these engines run at a speed of seventy-five revolutions, and the third at one hundred and sixty revolutions. This last runs its dynamo by means of a single belt, the other two by intermediate shafting. The engines are supplied by three semi-tubular boilers.

Each dynamo, at a speed of 600 revolutions, develops a current of 230 amperes with an electromotive force of 260 volts. The sets of accumulators are charged in parallel with a constant electromotive force of 260 volts. The batteries are left charging until they have absorbed a number of ampere hours equal to that which they have rendered in service, plus an increase, a total of which the output is 85 per cent. The number of ampere hours required to operate each line has been experimentally determined by means of a registering ammeter placed on a trial car. The duration of the charge is six hours for a battery which has furnished all its capacity of 230 ampere hours, or fifty-two horse power hours. The yield in energy of the batteries is as high as 70 per cent. The batteries in service with an electromotive force of upwards of 200 volts give a discharge, which on grades reaches 70 amperes, or nearly two amperes per pound of element. The average output on the level is about thirty-five amperes, which increases to fifty-five amperes on grades of 2½ per cent. One charge of the batteries will run the cars about forty miles on grooved rails and about seventy-five miles on ordinary T rails.

In order to operate the car at the various speeds required in service the coupling of the cells of battery is changeable. In the car the batteries are divided into four parts or sub-batteries, each of twenty-seven cells in series which give, on closed circuit, about fifty volts. By means of a regulating switch, placed at the disposition of the driver, the three following couplings of batteries may be obtained: The four sub-batteries in parallel, electromotive force, 50 volts; two sub-batteries in series, two in in parallel, electromotive force, 100 volts; four sub-batteries in series; electromotive force, 200 volts.

The speed of car is doubled in passing from one coupling to the other. The motors of the car are usually connected in series, but, by means of a switch, may be placed in parallel when greater speed or power is required, although this last combination is seldom used. This second switch also reverses the direction of running of the car by reversing the current in the motor armatures, and by it also a motor may be cut out of service in case of damage by short circuiting it on the series combination.

The daily service on the Madeleine route consists of one hundred and four trips, or fifty-two round trips. Seven cars are operated on this line, some making eight and others nine trips, about ninety-two and one hundred and three miles. Each car is operated with two sets of batteries, making from four to six consecutive trips, forty-six to sixty-nine miles without recharge.

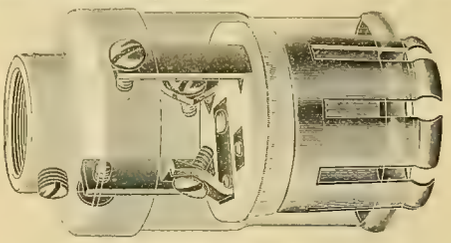
The Metropolitan Railroad company, Washington, D. C., had in use for several months two sets of chloride batteries. The car has run about 8,000 car miles, having made as much as thirty-three miles on one charge, and this on a road that has not a level foot on it, many of the grades being as heavy as six per cent., in addition to which there are over fifty curves. The chloride accumulator which is used in this installation is manufactured by the Electric Storage Battery company of Philadelphia.

Chicago to Washington.

The Big Four and Chesapeake & Ohio companies have issued a circular to delegates to the National Electric Light association, which will hold its annual convention at Washington on February 27th, in which attention is called to the facilities these companies has for handling visitors from Chicago and intermediate points. A rate of one and one-third fare on the certificate plan has been authorized for this meeting; i. e., delegates pay one first-class limited fare going, taking certificate from ticket agent at starting point. This certificate, when properly vised by the secretary of the meeting in Washington, entitles the passenger to a return ticket at one-third fare. The Big Four and Chesapeake & Ohio railways have vestibuled, steam-heated and electrically lighted trains, with through dining car service. The geographical situation of the Big Four makes it convenient for the delegates from Minneapolis, St. Paul, Omaha, Milwaukee, Kansas City, Chicago, St. Louis and Peoria to use this line to Cincinnati, where they will join the Queen City delegation and make the trip east over the picturesque Chesapeake & Ohio railway on the "F. F. V." limited. For the accommodation of delegates and their friends from Chicago, Milwaukee, St. Paul, Minneapolis and the Northwest a special sleeping car has been arranged for, to leave Chicago on Sunday morning, February 25th. Arriving at Indianapolis they will be joined by the St. Louis and Peoria delegations, and at Cincinnati by members from the South and Southwest.

New Keyless Socket.

The accompanying cut shows a new style of keyless socket which possesses some features of merit. This socket is designed especially for street fixtures, brackets,



NEW KEYLESS SOCKET

etc., where a socket is required to screw on pipe through which wires are led to the socket. The nipple is threaded for 3-8 inch gas pipe, and by reference to the cut it will be seen that there is a great abundance of room within the socket for disposing of the leading in wires. The sockets are made to fit Sawyer-Man, Thomson-Houston and Edison lamps and are manufactured by the Iona Manufacturing company, Boston.

Imperial Dry Battery.

The Imperial dry battery has been upon the market for some time, but during the last year improvements have been made in its construction which improve the efficiency of the

IMPERIAL DRY BATTERY.

battery to a considerable extent. A special effort has been made to make a dry battery that will retain its initial electromotive force during life to as great an extent as possible, and it is the result of the improvements that have been made in this direction in the Imperial battery that causes the manufacturer to claim many advantages to be gained

IMPROVED MAGNETO TELEPHONE.

by its use. The depolarizer used does not become a dead weight or resistance, and it is not possible for the battery to deplete itself by used up depolarizing matter, therefore the possibility of internal short circuiting is greatly reduced. It consumes material only when the circuit is closed, and will not, it is claimed, deteriorate when not doing work, thus possessing the superior merit of holding its initial force over long periods of time, enabling dealers to place them on their shelves without an appreciable deterioration. They are slow to polarize and quick to recuperate, and not liable to rapid failure, and it is almost impossible to so deplete the cell by exhaustive work that it will not do good service, hence, its efficiency is all that could be desired. They are hermetically sealed and remain so, and will not boil over or burst the seal, and oozing of the salts from the top is entirely eliminated. Its internal resistance is small and it possesses a high and quite constant electromotive force. The Imperial is not a closed circuit battery and should not be so used, but it is intended for all purposes for which an open circuit battery is used, and is constructed to meet all the conditions required for such a battery by the general trade. Its voltage is 1.5 and amperage from 7 to 10. Where higher amperage is wanted special batteries are made. The Miamisburg Electric company, Miamisburg, O., is the sole manufacturer.

Improved Magneto Telephone.

In the accompanying cut is illustrated a magneto telephone which has been placed upon the market by the Western Telephone Construction company of Chicago. The company owns the patents of the Stromberg and Carlson magneto telephone instrument, which were granted September 5, 1893. This is the instrument that was tested between Chicago and New York February 10th, with the results as stated in the last issue of this journal. The telephone is compact in every respect and of course requires no battery. The same magnets that are required for ringing the magneto bell, also furnish the current for the magneto transmitter. It transmits very clearly on long as well as short distance lines. In proof of this statement the company refers to the long-distance tests made last week between New York and Chicago.

In the magneto telephone the waves of sound created by speaking strike against and vibrate the plate or diaphragm, and the transmitting instrument which moves it to and fro generate the current of electricity, which passes through the conducting line to the receiving instrument, where the sound is produced. On this type of telephone the current is generated by the transmitting instrument, itself, and the variations in strength of the currents are produced by the extent of the movement of the plates or diaphragm of the receiving instrument and thus produces the sound waves. The clear transmission of vocal sound, the simplicity of adjustment and the economy of maintenance are the points of merit which are claimed for this instrument by the Western Telephone Construction company.

COMMUNICATION.

Storage Battery Litigation.

To the Editor of the WESTERN ELECTRICIAN:

The Consolidated Electric Storage company, controlling the Brush patents, knowing that in the chloride accumulator manufactured by the Electric Storage Battery company the defects heretofore developed in the various types of battery constructed on the principles covered by the Brush patents have been practically overcome, have finally found themselves in a position where they must either abandon the storage battery field or claim that the chloride system of storage did in some way infringe the Brush patents.

Not being able by a systematic circulation of such statements to deter purchasers of storage batteries from taking the chloride battery in preference to the inferior batteries made by the Consolidated company and its licensees, they have finally instituted suit, the only object of which, we believe, is to frighten intending purchasers of batteries, who are not familiar with the subject, by the idea that there may be some foundation for their claim of infringement, and thus delay as long as possible the time when the chloride battery will be the only battery that purchasers requiring a satisfactory system of storage will accept.

Without intrenching upon the province of the court, or venturing to forecast its judgment, we are advised by the best of counsel and the most eminent scientific experts in this country, after a most thorough examination of the state of the art, that we do not infringe the Brush or any other patents in the slightest degree. Among these experts are Professor Charles F. Chandler of Columbia college, New York, Professor George F. Barker of the University of Pennsylvania, and others, copies of whose opinions we will be glad to furnish to any who may be interested in reading them. We quote briefly from a joint report of Profs. Chandler and Barker, as follows:

NEW YORK, December 6, 1893.

W. W. GIBBS, ESQ.,
President Electric Storage Battery Company,
Philadelphia, Pa.

DEAR SIR:

In reply to your inquiries as to whether your chloride accumulator itself or the process by which it is manufactured or the way in which it is used in any way infringes the Brush secondary battery patents or any of them, we beg to make the following report:

Having been engaged as experts in the litigation between the Brush Electric company, the Julien Electric company and the Electrical Accumulator company, we are quite familiar with the Brush patents and with the interpretation which has been put upon them by

the judges of the United States Circuit Court and the Circuit Court of Appeals. * * *

You construct a composite plate consisting of tablets of chloride of lead and chloride of zinc in a frame of metal. There is no activo material in this composite plate nor is there any material ready to become active in a secondary ba tery. Nor is there any material which is absorptive in a secondary battery.

In fact, as far as any use of this composite plate in a secondary battery is concerned, it is practically inoperative a d worthless. Before any use can be made of this composite plate it must be exposed to a process of electrical disintegration, not in the bath or fluid of a secondary battery, but in a totally different bath in connec ion with plates of zinc. And only after this electrical disintegration is the plate of any use in a secondary battery. * * *

Our understanding of the Brush claims is confirmed by the language of Judge Shipman, which reads as follows:

"The mechanical application of a layer of lead oxide to each of two lead plates, before the plates are placed in the battery fluid, these coatings being at once active material and ready for the charging current, when immersed in the battery fluid, was, in general terms, the distinguishing feature of the Brush invention. * * * * These claims describe and necessarily refer to a secondary battery, as heretofore defined; a plate or support which is insoluble in the liquid mechanically supports the active material and electrically conducts the current of electricity through it; the specified active or absorptive material being oxides of lead, which are primarily mechanically applied to the plates and in such state of minute division as to be at once capable of being charged without previous process of 'formation' by electrical disintegration."

In conclusion we are, therefore, of the opinion that your battery does not either in itself, in the process by which it is manufactured, or in its use, infringe the claims of the Brush patents.

We are familiar with all the batteries that have been held to infringe the Brush patents, and in all of them the distinguishing features of the Brush invention as set forth in the above quoted passages of the opinion of the Court of Appeals were clearly present.

No battery such as yours has been held to be an infringement of the Brush patent, and from our understanding of the opinion of the court of last resort, the Circuit Court of Appeals, such conclusion would seem to be impossible.

(Signed) C. F. CHANDLER, PH. D.
G. F. BARKER, M. D.

A careful reading of these complete reports, we believe, will promptly convince any one informed on the subject that there is no ground for any claim of infringement, and that the only hope and expectation of the Consolidated company is to temporarily injure the business of the Electric Storage Battery company, which they have been endeavoring to do for many months past by the circulation of false letters and statements.

We therefore propose to continue making and selling our battery, and shall protect and save harmless all users of the chloride accumulator.

W. W. GIBBS, President.

Philadelphia, February 15, 1894.

A Large Electric Yacht.

It is reported that John Jacob Astor, who is said to be much interested in electricity, has given a contract to a New York firm for a yacht 90 feet long, the motive power of which is to be electricity. The craft is to be built of steel, and, according to the plans, it is to be one of the handsomest and most elegantly equipped pleasure boats in the country. Mr. Astor has had two smaller electric boats constructed during the last few years. The proposed boat will be equipped with storage batteries, which will be charged at Mr. Astor's private dock at Rhinebeck, on the Hudson, where is located his residence, in which has been installed a most complete electrical plant. This yacht when completed will be something of a pioneer in this line upon this side of the water, and in its operations will doubtless be watched with considerable interest by those who believe that the time is at hand for the successful application of electricity as the motive power of a larger class of vessels than those upon which it is used at the present.

Moonlight Schedule for March.

Following is the WESTERN ELECTRICIAN'S lamp lighting schedule for March:

Day of Month.	Light.	Day of Month.	Extinguish.	Number of Hours.
	H M.		H.M	H.M.
1....	P. M. 6 20	2....	A. M. 5.20	11.00
2....	" 6 20	3....	" 6.30	12.10
3 ...	" 6.20	4....	" 6.30	12.10
4 ...	" 6 20	5....	" 6 30	12 10
5 ...	" 6 20	6 ..	" 6 30	12 10
6....	" 6.20	7....	" 6 30	12.10
7....	" 6.30	8....	" 6.20	11 50
8....	" 6.30	9....	" 6.20	11.50
9....	" 7 30	10....	" 6.20	10.50
10....	" 8.40	11....	" 6.20	9 40
11....	" 10.00	12....	" 6.20	8.20
12....	" 11.10	13 ..	" 6.20	7.10
14....	A. M. 21.30	14 ...	" 6 10	5.40
15....	" 1.30	15 ...	" 6.10	4.40
16....	" 2.30	16....	" 6.10	3 40
17....	" 3.20	17 ...	" 6.10	2.50
18 ...	" 3.50	18....	" 6.10	2.50
19 ...	" 4 20	19....	" 6.10	1.50
20....	No light.	20....	No light.	0.00
21....	No light.	21....	No light.	0.00
22....	No light.	22....	No light.	0 00
23 ...	P. M. 6.40	23....	P. M. 10.50	3 20
24....	" 6.40	25....	" 11.00	4.30
25....	" 6 50	26....	A. M. 12.10	5.20
26....	" 6.50	27....	" 1.20	6 30
27....	" 6.50	28....	" 2 20	7.30
28....	" 6.50	Mar. 1	" 3.10	8.20
29....	" 6.50	30....	" 3.50	8.00
30....	" 6.50	31....	" 4.30	9.40
31....	" 6 50	Apr. 1	" 4 40	9.50
		Total.....		215.30

The foregoing schedule was calculated on the following basis:

Light one-half hour after sunset and one hour before moonset.

Extinguish one hour after moonrise and one hour before sunrise.

B. & O. Convention Special.

The Baltimore & Ohio Railroad company announces that it has made arrangements to run a special train of Pullman vestibule sleeping cars to Washington for the accommodation of the Chicago delegation. This train will leave Chicago, Sunday, February 25th, at 6:25 P. M., from the Grand Central Passenger station, corner of Fifth avenue and Harrison street. In the event of there not being a sufficient number of people to justify the running of a special train, the sleepers will be attached to the regular Limited train, leaving Chicago at the same hour. A rate of one fare and one-third for the round trip on the certificate plan has been secured for this meeting. The line of travel is one of the most picturesque in America. A special representative of the Baltimore & Ohio company will accompany the train to look after the comforts of the party.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 19.—The special committee of the Chamber of Commerce which was appointed to inquire into the rapid transit question made a report last Thursday at a special meeting of the chamber. Action upon the report was deferred for two weeks, when it will be taken up at a regular meeting. This delay was necessary in view of the recommendation of the committee and of its failure to give adequate consideration to an alternative for its proposed plan of action. Upon two very important points the report of the committee is explicit and conclusive. One is that the surface and elevated railroad systems do not and never can meet the requirements of the case. The committee does not declare for underground roads or for any definite plan, but it is clear on the question that elevated roads in the streets cannot give rapid transit, and that rapid transit must be had by some other means. The other point upon which the committee leaves no doubt, and which should be accepted as settled, is that, under existing circumstances and with the necessity of waiting some years for the development of the results of rapid transit, private capital cannot be induced to undertake any adequate measures. The alternative is the use of the city's credit and resources in some form or other. There are two ways in which the city may aid: First, by loaning its credit to a private corporation which shall furnish part of the necessary capital and undertake for itself the construction and operation of the rapid transit system under obligations to meet the payment of the bonds issued in its behalf; secondly, by the city's own use of its credit in a work of such benefit to itself and to its people, under contract with a corporation which shall construct, equip and operate the system for it. Which of these methods should be adopted depends upon which would be the safest, surest and speediest means of giving rapid transit.

The Board of Trade, as a representative body of men interested in the scheme of securing better transportation facilities, has taken up the subject. Last week it passed a resolution to the effect that the president of the board be authorized to appoint a committee of five members for the purpose of considering plans proposed for rapid transit, which should report to the board at a meeting to be held March 1st. Such a committee was appointed. In the meantime Mr. Bushe's elevated plan is being projected, money is being spent—some say uselessly—and protestations against this elevated road plan are becoming more and more pronounced. It seems a subject for regret that some man cannot be found who can assemble all the valuable thought which has been given this subject and allow New York people what they want—an underground electric road.

Last year an amendment to the bill allowing electrical experiments on the canal was added in the Assembly, providing that the superintendent of public works could grant the privilege of erecting wires along the berm bank of the canal to any electric company. No sooner was the bill a law than permission was granted to the Cataract General Electric company, which now holds the right and which is preparing to put up the wires. Last Friday in the State Senate Senator Parsons introduced a bill providing for the absolute repeal of the section of the law of last year providing for such a grant. Senator Parsons said that there had been a demand that such an exclusive and valuable grant be repealed. He thought that to give any corporation such a franchise without asking any consideration was ridiculous. W. F. O.

New England News.

BOSTON, February 19.—After long delay and protracted discussion, Boston is about to solve, or partially solve, the rapid transit problem. Boston's narrow streets and narrow sidewalks have become so congested by the increase in population and business that longer to delay in making an effort to secure relief cannot be tolerated. A bill was passed by the last Legislature, enabling the city to build a short subway through Tremont street to the northern railway stations, and also providing for the construction of a new thoroughfare from the northern railway stations out to Roxbury, cutting in between Tremont and Washington streets, this new avenue to be used by the street cars almost exclusively. This was regarded by many as the best scheme, as it would afford relief to both Washington and Tremont streets. Its cost, however, was found on investigation, to be too great for the city to undertake, as it would necessitate the destruction of much valuable property, and Boston was not quite liberal enough to expend so much money at one time, even to promote an enterprise that would give to the city a metropolitan air and increase her commerce and beauty. This season the subway scheme has been considered, and a modification and extension of last year's plans have appealed to a majority of Boston's business men so strongly that it is probable work will be entered upon it within a short period—as soon as the necessary permission can be obtained from the Legislature and the plan can be drawn. Mayor Matthews appointed a subway commission on January 1st, consisting of Thomas J. Gargan, George F. Swain and Charles H. Dalton. After consideration the commission has matured a plan which seems to meet with general favor. Last season's bill provided for a tunnel 3,700 feet long, at an estimated cost of $2,000,000. The new bill asks for permission to make a tunnel 10,000 feet leng, at an estimated expense, including land damages, of $5,000,000.

The chief difficulty in agreeing upon a rapid transit scheme has always been to provide for the great volume of travel between the Roxbury and Dorchester wards and the business part of the city. Hence it is proposed to begin the subway at the junction of Shawmut avenue and Tremont street, the surface cars for Jamaica Plains, Forest Hills, Eggleston Square and other contiguous portions of Roxbury, as well as the Tremont street lines, entering the tunnel at this point, a double track road being constructed as far as the intersection of Tremont and Boylston streets. A subway will be begun at the corner of Charles and Boylston streets, and will enter the main subway at Tremont, for the accommodation of the Back Bay, Columbus avenue, Brookline, Cambridge and Brighton cars. From the corner of Boylston and Tremont streets to the Northern railway station there will be four tracks. The northern entrance to the tunnel will be opposite the new Union station of the Boston and Maine and Fitchburg railroads. The car tracks will be eighteen feet below the surface of the streets. There will be entrances at the corner of Boylston and Tremont streets, at West street and the Park street church, at Scollay square and at Haymarket square. It is also possible that some of the larger stores may have entrances to the tunnel from their basements. As the cars will be, as now, run by electricity, and as the tunnel will be lighted by electricity, the ventilation of the tunnel will be perfect. The sides of the tunnel will be lined with white porcelain-faced bricks, and there will be tile drains and an iron roof. Mr. Olmstead will have charge of the approaches and the entrances, and that will insure an artistic appearance. Sidewalks will be run in the subway, which will be popular in stormy or warm weather. The bill also provides for the construction of conduits in the tunnel for electric wires, water and gas mains, and sewers. It is estimated that two years will be required to complete the work, which will be done in sections. The West End Street Railway company will be required to pay for the use of the subway, and the charge, it is now expected, will be equal to a moderate interest on the cost of construction. This project, if carried out as proposed, will be the beginning only of the solution of rapid transit. It will be more popular than an elevated road, but it must soon be followed by other schemes to relieve the congested condition of Washington and other streets. The sidewalks on Washington street for more than a mile are so narrow that the pedestrians overflow into the street every hour between 8 A. M. and 7 P. M. A big stretch of Washington street, all of School, Winter, Bromfield, Cornhill, Court, West and other streets are little, if any, wider than the sidewalks on Fourteenth and some other streets in New York. S. P. D.

PERSONAL.

I. C. Woodward of St. Paul, Minn., representing the Fort Wayne Electric company, was in Chicago last week.

C. J. Butler, manager of the Indiana Rubber & Insulated Wire company, of Marion, Ind., was in Chicago last week.

The London *Electrical Engineer* states that early in the coming spring Colonel Gouraud will have as his guest at Whitehall Court Thomas A. Edison, who is going to take a rest in Europe this summer.

NEW INCORPORATIONS.

Madison Light & Power company, Chicago; capital stock, $10,000.

Waukegan Electric Railway company, Waukegan, Ill.; capital stock, $500,000.

Electric Boat company, Chicago; capital stock, $100,000; Charles D. Wright, Chicago, Ill.

Abingdon Electric company, Abingdon, Ill.; capital stock, $12,500; to operate an electric light plant.

Acme Lighting company, Chicago; capital stock, $15,000; to manufacture and deal in inventions, patents, etc.

Louis K. Comstock company, Chicago; capital stock, $20,000; to do general electrical engineering and construction.

Rock River Electric Railway company, Rockford, Ill.; capital stock, $500,000; to build a railroad from Rockford to Dixon; James Tickenor, Rockford, Ill.

TRADE NEWS.

The "Mac" tape, which was introduced by the Metropolitan Electric company, Chicago, some time ago, is rapidly finding favor with the electrical fraternity, as the orders of the company will show.

James B. Olson, the well known manager of the western office of the New York Insulated Wire company, has just returned from a trip through the Southeast, where he has taken a number of orders. Mr. Olson thinks the prospects for a large business during the year very good.

The illustrated book issued by the Hornberger Electric Manufacturing company, Elkhart, Ind., descriptive of the Elkhart transformer of the tooth type, is an interesting work which contains not only information concerning the company's instruments but a number of splendid testimonials of the success in the operation of them. The company is modest in its assertions, but states that it is prepared to substantiate all its claims. In the mechanical construction of the converter the outer magnetic circuit is unbroken, the laminæ are placed in the case under hydraulic pressure, thus making them practically noiseless. The core pieces, when placed in position, occupy a V shape cut in the outer laminæ, and by means of the wedges it is possible to reduce the magnetic resistance to a minimum by practically making each lamination one piece of iron. The book is carefully compiled and contains many hints to purchasers of converters.

BUSINESS.

The Gibson Gas Fixture works, Philadelphia, dealers in gas and electric light fixtures, have made a number of large sales through their western office, 171 South Canal street, Chicago, during the last month.

The Metropolitan Electric company, Chicago, has made a number of large sales of the "P. & B." products since being appointed the general western agent. A number of barrel lots were sold by the Metropolitan company within the last week.

C. E. Lee, 65 Lees building, 147-153 Fifth avenue, Chicago, representing the Abatis Electric Manufacturing company and the Chicago Gauge company, is handling the Samson battery and electrical specialties in general. Mr. Lee also keeps in stock fan motors and all kinds of primary batteries, annunciators, etc.

The Western Electric Building & Loan association has completed the first year of its existence, and its first annual statement shows the association to be in a sound condition. The earnings have averaged 12 per cent. for the year. All the principal officers are or have been connected with the Western Electric company, Chicago, for a number of years.

Apropos of the convention of the National Electric Light association at Washington, it may be mentioned that Allen R. Foote, National Statistical association, Washington Loan & Trust company building, Washington, is prepared to secure hotel accommodations and to attend to other matter which would be of service to the members of the association. Mr. Foote can also attend to arrangements for printing cards, circulars, etc.

E. F. Seixas, who was for a long time identified with the Edison interests and later with the *Street Railway Gazette*, has entered the offices of J. L. Barclay, 1645-8 Monadnock building, Chicago. Mr. Seixas will especially exploit the street railway apparatus manufactured by the Walker Manufacturing company of Cleveland, O. This company's reputation for high grade engineering work in street railway and power transmission should greatly benefit Mr. Seixas' efforts in this field.

The Independent Electric company, Thirty-ninth street and Stewart avenue, Chicago, manufacturer of fuse wire and mining machinery, has added a new department to its business and is now prepared to furnish promptly a high quality of slate for all purposes, but with special reference to the requirements of electrical work. The company cuts to any size and furnishes plain and finished slate in any desired manner or quantity.

Hood & Osburn, 239 LaSalle street, Chicago, general western agents for the La Roche Electric Works, have just closed a contract with the Hammond, Ind., Electric Light & Power company for a 1,300 light alternator of the La Roche type. As the sale was made in the face of strong competition the firm feels considerably elated over its success. Hood & Osburn report that business is improving and that the prospects for the introduction of La Roche machinery during the coming year is bright.

The Mica Roofing company, whose Chicago office is located at 500 Boyce building, is pushing the sale of the "Mica" electrical insulating compounds. These compounds are for all electrical purposes where a perfect insulator is required. They contain no acid, and consequently there is no deposit of copper sulphate. The minimum resistance to electrical pressure is greater than usual. They are waterproof and contain no water. They are for use on armatures and field coils; painting wires and cables when laid in damp places; to protect underground lead covered telehpone and electric light cables from earth gases, and also from the ground current from electric street railways; to protect wires and cables from acid fumes; to make cut-out boxes waterproof; for painting manholes, made of either wood or brick, and to saturate the braided cotton covering of cables.

The city of Washington is an object of perennial interest to all patriotic Americans. Not alone because it is the great throbbing heart of the mightiest and grandest republic the earth has ever known, but also on account of its material magnificence. The Baltimore & Ohio railroad offers unequalled facilities of transportation to this point. All its through trains between New York, Philadelphia and Baltimore on the East, and Pittsburg, Cincinnati, St. Louis and Chicago on the West, pass through Washington. Its fast express trains are vestibuled from end to end and heated with steam. Pullman's latest and best productions in the way of sumptuous drawing room sleeping cars are attached to all through trains. The present management of the Baltimore & Ohio has made vast improvements in the last two years, and the road is to-day one of the foremost passenger carrying lines in the country. Through tickets via. the Baltimore & Ohio railroad can be procured at all the principal ticket offices throughout the United States.

The Washington Electric company, 197 and 199 South Canal street, Chicago, has been for some time reaping the rewards of a liberal use of printer's ink, and it reports as the direct results of judicious and extensive advertising, that it is receiving many large and remunerative orders from all parts of the country for its alternating current lamps, the sale of which it has been pushing for some time. This lamp is simple, effective, strong and durable, not liable to get out of order, positive in action, practically noiseless and complete in all details. The company now intends to direct its energies particularly to the sale of Meissner's Imperial rheostat and stage dimmer. This specialty has been upon the market for some time and is well known. Contact in this device is made upon the wires direct instead of a segment face, and the changes from light to dark and vice versa are made perfectly even and gradual. These dimmers are incombustible, durable and compact. Another article in this line to which attention is being attracted is Meissner's improved theatrical focusing lamp, which possesses many noteworthy merits. The Washington Electric company is also selling Meissner's focusing lamp for photo-engraving and stereoscopic work. These are all standard articles which have been in constant demand for some time.

The Central Electric company, Chicago, has been made the sole western agent for the Kinsman desk light, manufactured by McLeod, Ward & Co., 91 Liberty street, New York. This arrangement is one of the latest and best novelties in the electrical line that has been placed upon the market. It is intended for incandescent lights and can readily be attached to any desk. The desk can be opened or closed without interfering with the light, and by means of its rotary reflector the desired quantity of light can be obtained. The Central Electric company is also handling an outfit concerning which many inquiries are being received, and many sales made, in the combined exhaust fans and Lundell motors. This consists of a Lundell motor directly connected to a fan, and it attracts much attention from the simplicity of its construction and the convenience of its use. The fan is placed in a suitably constructed box, either above or below the window sill, which protects it from the weather. The motor is controlled from within, and the sash is free to be raised or lowered at any time, except when the fan is in operation. The company has been handling large orders lately, and reports business in its specialties as being good. The windows of the company's store are full of novelties, and everything new is added to the stock as soon as it is placed upon the market.

ELECTRICAL PATENTS.

Issued February 13, 1894

514,460. Electrical Conductor. Dallas B. Hayward, Easton, Md.

514,461. Electrical Signal Apparatus. George W. Hey, Syracuse, N. Y.

514,462. Electrical Apparatus. George W. Hey, Syracuse, N. Y.

514,480. Cut-out. Hermann Lemp, Lynn, Mass.

514,491. Electrical Firearm. John L. McCullough, Brooklyn, N. Y.

514,501. Electrical Annunciator. Charles F. Scattergood, Albany, N. Y.

514,504. Current Regulator for Dynamo-electric Machines. Charles E. Scribner, Chicago, Ill.

514,505. Electric Arc Lamp. Charles E. Scribner and Ernest P. Warner, Chicago, Ill.

The series or lifting magnet is mounted upon the frame of the lamp, and its armature is carried upon a pivoted lever which supports the shunt magnet, the armature of the shunt magnet being mounted upon one end of a bell crank, whose other end is connected with the clutch of the carbon rod.

514,506. Electric Arc Lamp. Charles E. Scribner, Chicago, Ill.

The invention comprises means for burning two pairs of carbons successively, each pair of carbons being provided with a lifting magnet and a feeding magnet in a shunt around both the carbons; circuits connect the lifting magnets in series, and the pairs of carbons in multiple with each other and in series with the lifting magnets.

514,524. Influence Machine. Harry F. Waite, New York, N. Y.

514,554. Magazine Fuse for Electric Circuits. Charles E. Jones, Cincinnati, O.

514,561. Electric Railway. Paul W. Leffler, Minneapolis, Minn.

514,566. Electric Railway Crossing Signal. Michael J. O'Sullivan, Baltimore, Md.

514,580. Apparatus for Testing the Resistance of Conductors of Electricity. Elmer G. Willyoung, Philadelphia, Pa.

514,581. Electrical Measuring Instrument. Elmer G. Willyoung, Philadelphia, Pa.

514,582. Electrical Measuring Instrument. Elmer G. Willyoung and Madison M. Garver, Philadelphia, Pa.

The instrument is of the type in which the current to be measured traverses a conductor to cause the linear expansion of the conductor, the extent of the expansion being indicated by a pointer connected with the free end of the conductor.

514,583. Electric Arc Lamp. John E. Woolverton, New York, N. Y.

The lamps comprises an upper pair of convergent rods, one or both of which may be arcing electrodes, and a lower pair of convergent rods; the means for equalizing the feed of the carbons comprising a lazy tongs mechanically connected with the rods and actuated by the feeding mechanism.

514,586. Electrical Transmission of Power. Charles S. Bradley, Yonkers, N. Y.

The system comprises a continuous current generator, a phasing device electrically connected therewith for converting the continuous currents into alternating currents of differential phase, and an electric motor, the field magnet of which is charged by a continuous current, and the armature of which is charged by the alternating currents of differential phase.

514,593. Electrical Measuring Instrument. Madison M. Garver and Elmer G. Willyoung, Philadelphia, Pa.

514,641. Electric Pendulum Clock. Henri Campiche, Geneva, Switzerland.

514,651. Electric Cigar Lighter. Alexander J. Graydon, Indianapolis, Ind.

514,665. Pole for Electric Railways. Edward W. Serrell, New York, N. Y.

514,681. Electrolytic Cell. Ernest A. LeSueur, Ottawa, Ont.

514,695. Telephone. Charles T. Bloomer, New York, N. Y.

514,697. Electric Alarm for Pressure Gauges. William H. Bradt, Troy, N. Y.

514,718. Electric Railway System. Paul W. Leffler, Minneapolis, Minn.

514,739. Incandescent Electric Lamp. George H. W. Timbrell and John C. Fyfe, Denver, Colo.

A transparent tube extends into the globe from the base end of the lamp, and a rod provided with reflecting surfaces is adapted to be inserted into the tube, the filament being coiled about the tube, and the light therefrom reflected by the reflecting surfaces.

514,745. Safety Attachment for Telegraph Signals. Charles W. Babbitt, Jackson, Mich.

514,746. Apparatus for Periodically Completing and Interrupting Electric Circuits. Ernest L. Berry and Frederick Harrison, London, Eng.

514,775. Electric Alarm. Samuel T. Sanders, Granite, Mont.

514,801. Trolley. John A. Williams, Altoona, Pa.

514,813. Electric Lock. Robert V. Cheatham, Louisville, Ky.

514,817. Armature Connection for Dynamos. Oza Dufault, Spencer, Mass.

514,822. Insulating Joint. Emil F. Gennert, Brooklyn, N. Y.

514,823. Telephone Signaling System. Webster Gillette, New York, N. Y.

514,827. Electric Railway Conduit. Robert I. Hampton, Athens, Ga.

514,845. Electric Battery Cell. Peter C. Burns, Peru, Ind.

514,849. Electric Cable. Theodore Guilleaume, Cologne, Germany.

514,850. Electric Switch for Railroads. William M. Henderson and William C. Henderson, Philadelphia, Pa.

514,878. Electrically Operated Street Indicator for Cars. Henry C. Barker, St. Louis, Mo.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents expiring during the week ending February 13, 1894:

187,310. Voltaic Plasters. W. B. Potter, Boston, Mass.

187,318. Circuit Closers for Electric Railway Signals. D. Rousseau and W. C. Smith, New York, N. Y.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, MARCH 3, 1894. No. 9

Electrical Development in the Patent Office.

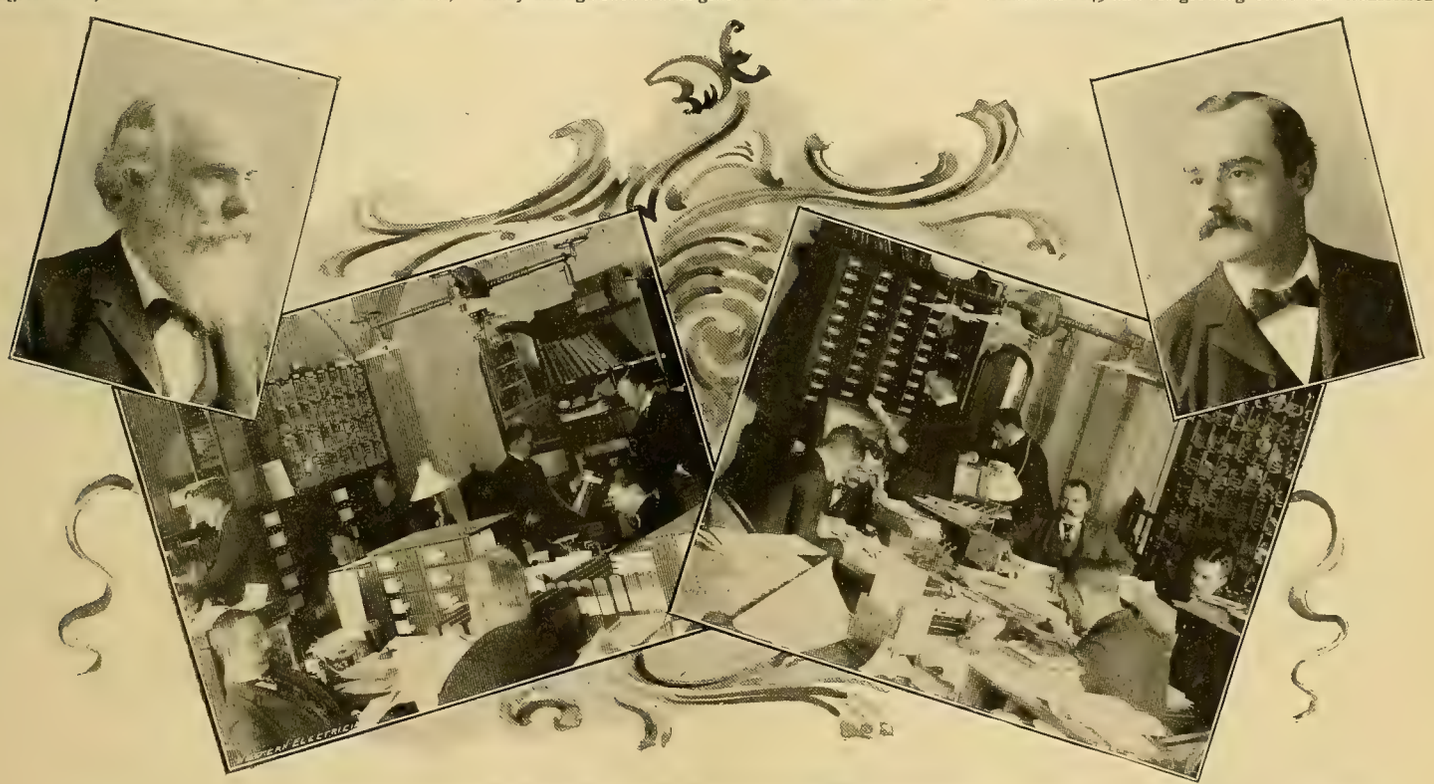
By E. E Clement.

The United States Patent Office enjoys the distinction of being some sixty years older than the executive branch of the government of which it is a bureau. Its age alone, therefore, if not its record, should make it respectable. The second act of our virgin national legislature was to pass a tariff law (its first being to prescribe an oath for government officials), but the patent system gets ahead even of the tariff, important as that seems always to have been, for folks had scarcely got done thinking of the Declaration of Independence before instinct told them to look out for the future. They put the inventor into the Constitution, and there he is, to stay.

The first act under this constitutional authorization was passed in 1790. It held water for three years, and then congress thought it could do better. As a matter of fact, and it was in his department that the clerical work of issuing patents was performed. It was his custom to call in the secretary of war and the attorney general to assist him in his deliberations over the applications that first made their appearance. Very few patents were issued.

In the years that intervene between 1802 and 1836, there was an officer who appears to have lifted the onerous responsibility of deciding patentability from the shoulders of the secretaries, at least the supervision of issuing patents. He was entitled "superintendent," and was a functionary of the state department. Four gentlemen held the office successively, William Thornton, 1802 to 1828, Jones, 1828 to 1830, Craig, 1830 to 1836 and Pickett. It was under Craig that Harrington's patents were issued.

The first commissioner of patents, so styled, was Henry L. Ellsworth. He was followed by Edmund Burke; and many distinguished names graced the office after. Com-



George D. Seely. ELECTRICAL DEVELOPMENT IN THE PATENT OFFICE.—EXAMINERS IN DIVISIONS 16 AND 26. Gustav Bissing.

the rigid spirit which governed in the granting, or rather refusing to grant patents, during these three years, produced a reactionary feeling, and the consequence was what might have been expected; that is to say, the law of 1793 was very much less rigid in its requirements; the granting of patents becoming then almost ministerial in its nature, to the exclusion of any consideration of novelty or utility. From 1793 to 1836, quite a long period for any infant industry to rest undisturbed by Congress, the mill ground slowly, but inventors were gradually waking up to the possibilities of the future. In 1836 a third act was passed, on which the present system, and the enormous prosperity of our country virtually rest. Prior to this act three electrical patents only had been granted, one each in 1833, 1834 and 1835, all three to the same man—one Harrington—and all three for electro-therapeutics—electrodes for medical use. These patents have no numbers, as our present system began under the new law in 1836.

A grant of a patent in those days was a great affair, particularly in the first few years, when the novelty of the thing made it an attractive plaything for greatness. Thomas Jefferson, who has been very aptly termed the 'Father of the Patent System," was secretary of state; missioner Ellsworth's daughter, it will be remembered, was the authoress of the first message sent over any telegraph line in America. Ellsworth was a life long friend and college classmate of Samuel F. B. Morse and when Morse had despaired of getting his appropriation bill through Congress in 1842, it was Miss Ellsworth who carried to him the intelligence that his bill had passed one minute before midnight, when the Senate was about to adjourn. In the exurbance of his joy, he exclaimed that she should send the first message. Every one knows what that message was: "What hath God wrought."

Up to 1839 the Patent Office, continuing attached to the state department, had occupied two different buildings. The first was on the site of the old war department building, from which it went in 1812 to a building situated where the postoffice department is now. This building was burned, and the same act of Congress which created the examining system and the office of commissioner, appropriated $108,000 for the erection of a suitable fire proof building for the Patent Office. In 1810 and 1812 appropriations were made for the purpose of building or renting "a General Post Office, and an office for the Keeper of the Patents."

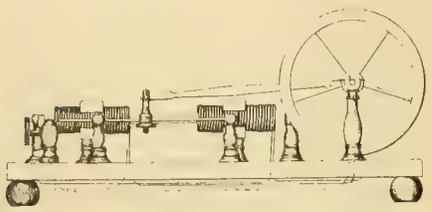
In this same year, by the same act, the office was elevated to the dignity of a separate bureau, and its force attaining the modest number of seven—one chief clerk, an examining clerk, three other clerks, a machinest, and a messenger. It is amusing to note that the examining corps, alone, contains to-day nearly two hundred, while a small army of clerks and other employes are needed to keep producing the five hundred weekly bits of sealed paper that mean so much to the inventors—and their attorneys.

I suppose the solitary examining clerk gave his attention partially to electrical matters; for electrical patents were beginning to issue right along, sometimes skipping a year, to be sure, but showing a steady progress, nevertheless. For twenty years matters went on very quietly. The force was increased from time to time, and as it grew it separated naturally into several divisions. In the meantime the Interior department was created in 1849 and the growing office was transferred to it as a bureau, while electricity and electrical inventors were beginning to attract a fair share of attention. From the purely theoretical scientific investigations of Franklin and Henry, the modern American utilitarian spirit began to manifest itself, and showed the lusty vitality that led to the plaint among savants in Europe that there is wasted by Americans in practical applications an amount of mental force, that, applied to purely theoretical researches, would permanently establish our fame, and enrich the world. Or, as Max O'Rell puts it, we attain our objects too much by sheer brute force of intellect.

Toward the close of the twenty years already alluded to the subject of natural philosophy, as it was called, was attaining proportions which soon called for its separation and assignment to a separate examining division in the office. A number of important electrical patents had already been issued. In 1837 and 1838 three motor patents went out; in 1839 one for lightning rods; in 1840 the original Morse telegraph with its two reissues, and the Wheatstone & Cooke patents, were granted. In 1846 Morse patented a register; in 1848 and 1849 we find an induction coil, another Morse register and Bain with two patents, a friction generator, and an automatic telegraph.

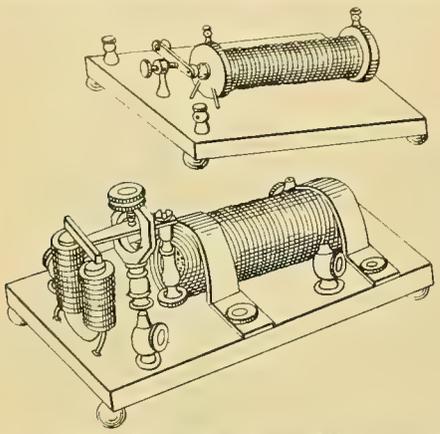
In 1852 House received the first patent for a printing

telegraph, and the late veteran of the electrical stage, Moses G. Farmer, first appeared with a bell, and a year later with a telegraph. In 1854 Page's motor came out, patent No. 10,480—quite a respectable number. A description of this motor is given in another place. In 1854 a distinguished visitor came to our shores and went back not empty handed. Thomas, Earl of Dundonald, an Admiral in the British Navy, received a patent for his invention of a conductor.



PAGE'S MOTOR—1854.

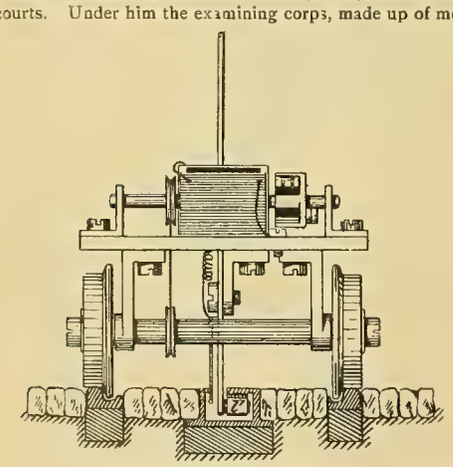
It will be noticed by a glance at the diagram of growth given on page 101 that about the year 1857 the number of electrical inventions first began to take a decided upward path. At that time W. B. Taylor, now connected with the Smithsonian Institution, and a distinguished scholar, was head of the philosophical division where electricity was examined. He conducted it for nearly twenty years and was succeeded in 1792 by Zenas F. Wilber, who gave place in 1877 to Henry C. Townsend. In connection with chemistry, which also included electrical matters at one



PAGE'S INDUCTION COIL—1868.

time, Examiners B. S. Hedrick and D. S. Stuart should be mentioned. The philosophical division included horology, instruments of precision, etc.

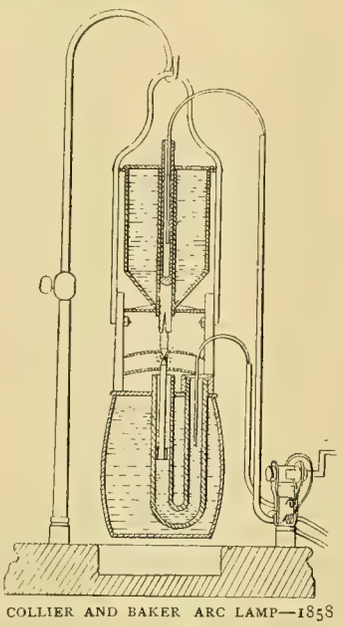
It might be interesting here to have an explanation of the word "Division," as used in the Patent Office. Unlike most government bureaus, there have never been any middlemen in the Patent Office. The head of the office is the commissioner, and for his judicial acts he is responsible to no one; though his decisions may be appealed to the courts. Under him the examining corps, made up of men



FIELD CONDUIT—1883—APPLICATION FILED MARCH 10, 1880.

supposed to be skilled specialists, works independent of other control. For convenience the corps has been subdivided, and its separate integral parts are called divisions, consecutively numbered. Each has to do with a separate class of inventions, and consists within itself of a principal examiner and several assistants. The acts of the principal, sometimes called the primary, examiner, are reviewable by the commissioner on appeal, and also in certain cases by an appellate board of three provided by law. At the present time Divisions 16 and 26 are the electrical divisions, called "A" and "B" since their creation.

Prior to 1880 the philosophical division occupied a room on the north side of the Patent Office; but being broken up, electricity was separated for the first time, assigned to Division 16, and given the quarters it has since occupied. During Examiner Wilber's time the famous Bell patent of 1876 was granted. At that time the principal examiner is said to have personally examined electrical matters. Examiner Taylor, Wilber's immediate predecessor, passed Edison's first patent, copies of which have been in such demand that the edition is exhausted. It is 90,646, dated June 1, 1869, for a vote recorder and indicator. In the year 1880, five hundred and fifty electrical patents were granted, incandescent lamps, and telephones being noticeable for their number. From this the number increased steadily and in 1883 another electrical division was provided for, but re-

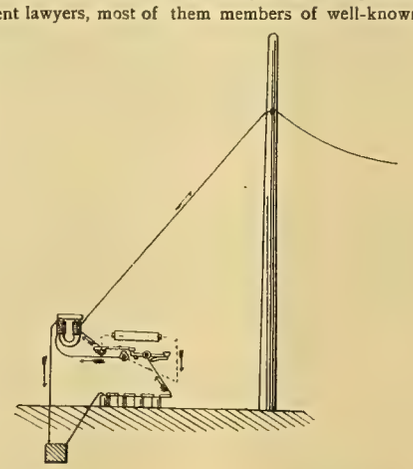


COLLIER AND BAKER ARC LAMP—1858

mained unorganized until 1887. The principal examiners of the two divisions have been:

	XVI.	XXVI.
1881.	Frank L. Freeman.	.....
1883.	Charles J. Kintner.	.....
1885.	Frank J. Brown.	.....
1887.	Frank J. Brown.	Geo. D. Seely.
1889.	Gustav Bissing.	.....

Of these, Mr. Freeman is in the firm of Foster & Freeman of Washington; Charles J. Kintner is enjoying a prosperous practice in New York; and Mr. Brown is fully as successful in Chicago, where he is at present the senior member of the firm of Brown & Darby. Of about forty persons who have served as principals and assistants in these two divisions since 1880, twenty-one are in practice as patent lawyers, most of them members of well-known



HUGHES' DUPLEX TELEGRAPH—1859.

firms; and four of the assistants are now principal examiners of other divisions. Fourteen constitute the present force as follows:

DIVISION 16.

Principal Examiner—Gustav Bissing, Ph. D., (Johns Hopkins University.)

Frank M. Ward, M. D., (St. Mary's College and Georgetown.) Telegraphy.

William A. Cowles, C. E., (Yale College.) Electric Lighting.

James Colwell, L. L. B., (Naval Academy and National University.) Railway Signals.

Edward E. Clement, L. L. B., (Naval Academy and National University.) Municipal Signals, Telephones, etc.

George C. Wedderburn, L. L. B., (Georgetown University.) Safety Signals and Switches.

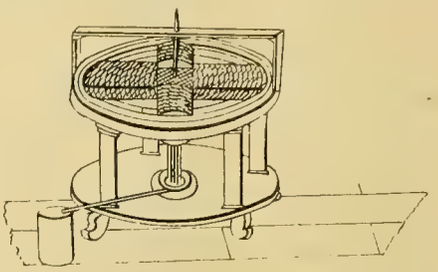
Myron F. Hill, A. M., (Harvard College) Telephone Systems.

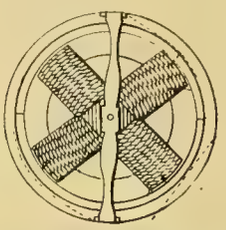
DIVISION 26.

Principal Examiner—George D. Seely. (Yale, 1859.)

H. L. Morton, M. E., (Ohio State University.) Electric Railways, Telpherage.

Miss S. J. Noyes, (the first lady appointed as Second Assistant Examiner, and who has seen the longest service





DAVENPORT'S MOTOR—1837.

in the electrical division) Continuous Current Motors, Systems of Distribution, etc.

A. P. Shaw, (Lehigh University.) Magneto-Electric Machines, Galvanometers, Meters, etc.

C. F. Chisholm, Ph. B, L. L. B., (Cornell University.) Motors and Regulators, Alternating; Transmission of Power; Rotary Transformers.

C. K. Wead, A. M. Electric Railways, Conductors, etc.

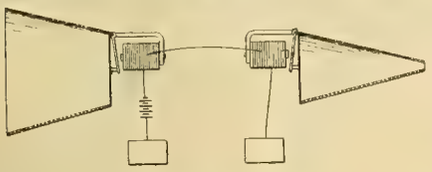
T. C. Newton, A. M, (University of Georgia.) Regulators, Insulators, etc,

These two divisions occupy several rooms on the ground floor on the F street wing of the Patent Office. While there are other divisions in the office which handle work of as great importance in an industrial sense, no work could require more careful attention and a more alert attitude of mind than this on the part of those who examine it. It has been estimated that one in every eleven patents is of some actual value. Inasmuch as there have been granted over 23,000 electrical patents it must be obvious that the large number of these which are of value would prohibit slighting even of applications for inventions considered to be of no value, lest an injury be done. It is impossible, without writing volumes on the subject, to give an adequate idea of the amount of important work that has passed through the electrical channels in the office.

The very first electrical patent issued under the new law of 1836, was numbered 132, dated February 25, 1837, to Thomas Davenport, for his famous and ill fated motor Davenport's misfortunes with this motor constitute a a curious chapter in the history of electricity. He was a country blacksmith, living at Brandon, Vt. By accident he became possessed of one of Prof. Henry's magnets. Despite his lack of education he managed to aquaint himself with the principles involved, and by the summer of 1834 had produced the motor which forms the subject of this patent. It will be observed by consulting the accompanying illustration that the machine is of rotary type

the first, with one exception, that is known to have been produced. The armature consists of a four armed electro magnet, while the field as shown is composed of permanent steel magnets. The wires leading from the battery-cell shown at the left of the figure conduct the current to the commutator formed of copper plates. The claim in this patent is certainly broad enough. It is as follows:

Applying magnetic and electro-magnetic power as a moving principle for machinery in the manner above de-

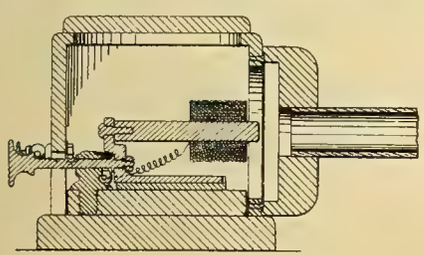


BELL'S TELEPHONE—1876.

scribed, or in any other substantially the same in principle.

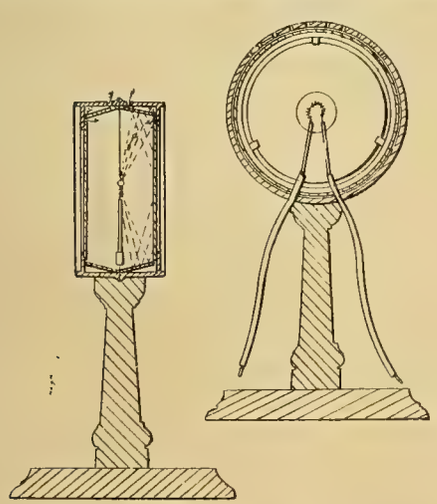
This machine was exhibited in Washington before the president, and at other places. It always attracted crowds, but its magnetic power seems to have stopped short of enticing the nimble dollars from American pockets; so Davenport concluded to send it to England. John Bull surrendered at first sight. Money was subscribed and a very large machine was built having a fly wheel six feet in diameter and weighing 600 pounds, which revolved at seventy-five turns a minute.

Wheatstone, Daniell, Faraday, and other famous men of the time went to see it. They all lost their heads except Faraday. He first nearly stopped the fly wheel by pressing a broom handle against it, and then told the promoters of the machine that it might be best for them if he suppressed his opinion. They did not press him for it.



BELL'S TELEPHONE—1877.

Three years after Davenport's patent had issued Wheatstone & Cooke and Samuel F. B. Morse appeared before the office. It is a curious fact that the Englishmen's application was executed three and a half months and their patent issued ten days before Morse's. Of course this fact has no bearing on the question of priority of invention in view of Prof. Henry's paramount title. Three figures, taken from Morse's drawings, are given herewith as exhibiting the three principal features of invention

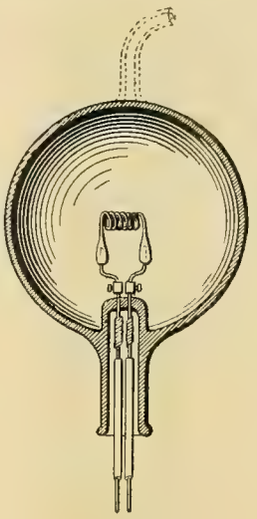


GARDINER AND BLOSSOM INCANDESCENT LAMP—1858.

described. The first is the transmitter, in which type with indented faces were set up in a rule and the rule reciprocated beneath a lever, causing the make and break through the agency of a bent wire dipping into two mercury cups connected to line. The second figure is a receiver which, as well as the third, scarcely needs explanation. The magnet at the left of the receiver controls the movement of the recording pen or pencil. Morse's patriotism is exhibited in the title which he gives his invention: "The American Electro-magnetic Telegraph." He has some twenty figures in his drawings and nine claims, the third one of which covers the entire use of electro-magnets for telegraphy. This claim was not sustained when it got into court and the patent was twice reissued.

The Wheatstone & Cooke patent has twenty-one printed pages of specification and nine claims. It shows simply the well known form of needle telegraph.

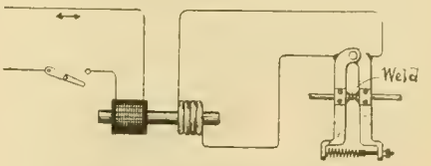
About 1850 Prof. Charles G. Page set about constructing an electric motor, with which, in 1851, he made a trial trip on a specially constructed car between Bladensburg and Washington. It was claimed to be of sixteen horse power, and was provided with one hundred cells of Grove's nitric acid battery having platinum plates, eleven inches square. A distance of five miles and a quarter was passed over in thirty-nine minutes. When within two miles of Bladens-



EDISON INCANDESCENT LAMP—1880.

burg, the power of the battery being fully up, the car began to run on a nearly level plane at the rate of nineteen miles an hour. This velocity was kept up for over a mile, but some of the battery cells were broken by the jarring of the car, and considerable time was lost in stoppages. On the whole the experiment was a failure, inasmuch as it was found that the slightest jar would throw out the batteries. Page's patent is dated January 31, 1854 and was numbered 10,480. One figure of the drawing is given. The circuits pass from the solenoids to a commutator on the shaft of the fly wheel, giving a reversal at the end of every stroke.

Patents are the mile stones of progress, and along the road of electricity, at first few and far between, we are now passing them at an astonishing rate. In considering the growth of inventions we find there are two aspects to the question. One is a broad view which takes in the efforts of various inventors; suggestions made from time to time in scientific publications, accidental discoveries, and all those circumstances which go to make one forward step. The other, a more restricted view, is only of results, and these are perhaps best evidenced by our patents. Thus, the first arc and the first incandescent lamp ever brought to the point of patenting in this country were patented within two months of each other, in the year 1858. A figure of each is given below. The first was patented by Collier & Baker, the second by Gardiner & Blossom. In the Collier & Baker patent the germs of several important inventions are exhibited. The carbons play in tubes and are forced together by mercury contained in these tubes, in the upper one by the weight of the mercury in the holder, and in the lower one by the buoyancy of the carbon pencil itself. A bridge piece with a small hole, through

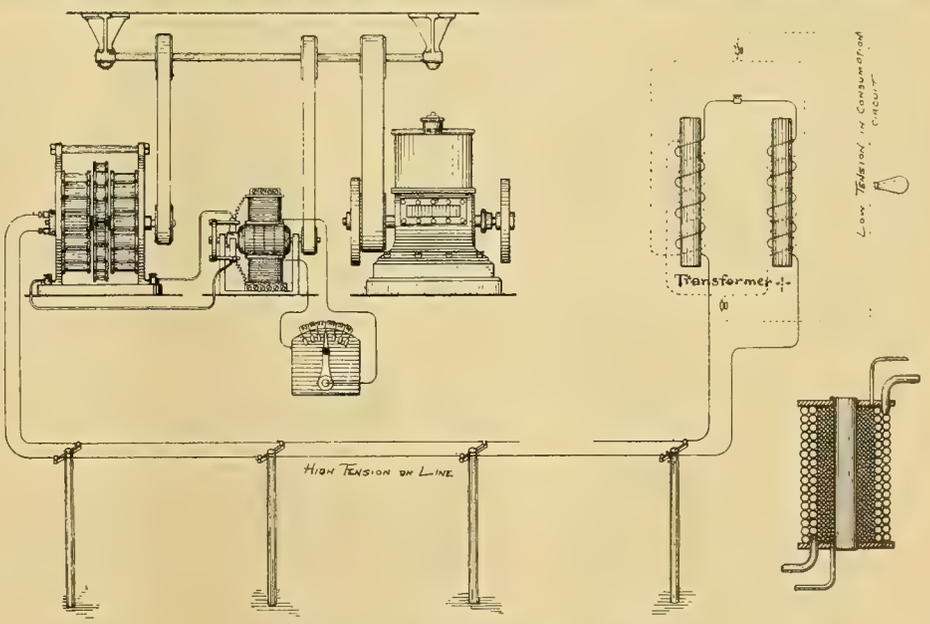


THOMSON'S WELDING—1886.

which the pointed end of the upper carbon protrudes, allows it to feed down slowly as it is consumed. And in order to insure equal consumption of both carbons a commutator is provided for reversing the current. Curiously enough the specification expresses the basic idea of Thomson's Welding Process. It says: "We find by long continued experiment that by employing in our apparatus an electric current of very low intensity but large volume, we are enabled to successfully use the carbon points in contact."

The incandescent patent granted to Gardiner is simpler. It shows aglass lantern containing a little coil of platinum wire connected with leading-in wires. This was granted eleven years after the death of young Starr, of Cincinnati, and twenty years after the date claimed by de Changy. The patent is of interest for no other reason than its age, for no vacuum was used.

On January 4, 1859, Prof. Hughes received his duplex telegraph patent. This may be understood by a glance at the figure shown. The apparatus at each station consisted of a ground plate, a battery, and magnet, each connected with the ground, and a reversible connection between the battery and the magnet consisting of two branches, one branch going to line and the other through a resistance tube filled with water to ground. When the key shown was pressed, it opened the line path through both coils of the magnet, and allowed a local battery current to traverse the coils of the magnet, part to one coil and line and part to the resistance and through the other coil of the magnet to ground. The armature of the magnet being polarized, and normally adhering, would not be released by this local impulse, because the coils neutralized each other. Any impulse from the other end, however, would pass through the coils in the proper direction to polarize the magnet and release the armature. This patent was assigned to the American Telegraph company. It contains but one claim.

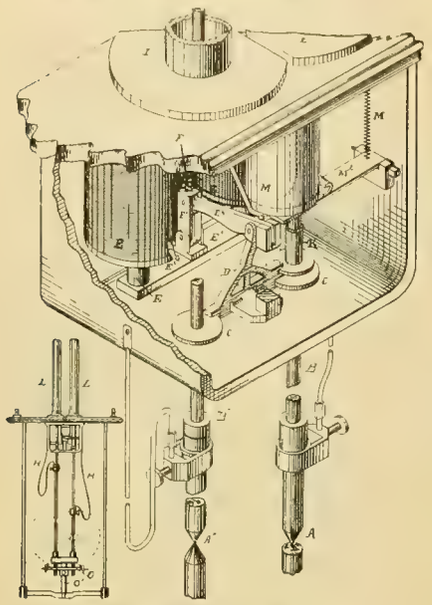


GAULARD AND GIBBS TRANSFORMER SYSTEM—1886.

Every great electrical invention has been more or less quarreled over, and the induction coil is no exception to the rule. The first patent for an induction coil in this country is dated in 1848, but Page's patent, which is probably the best known, was not issued until twenty years later. It is not thought description is necessary, in addition to the figure given. It will be observed that the cir-

cuit breakers are shown actuated both by the main core and by an auxiliary magnet.

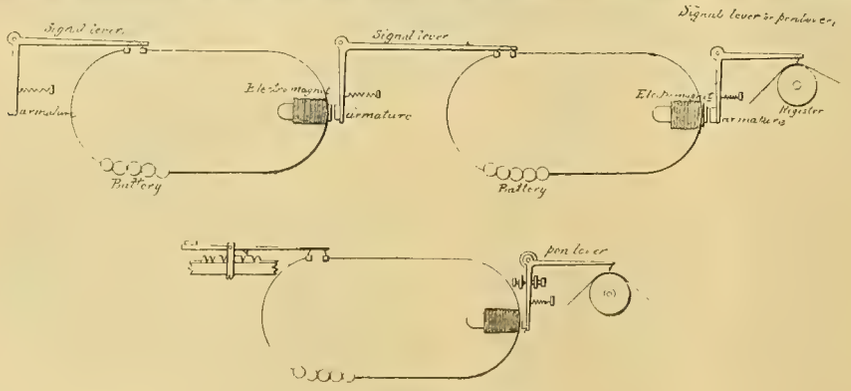
There is one patent, which without having attracted more than passing attention at the time of its issue has since been in almost unparalleled demand, the first granted to Thomas A. Edison. The government edition is exhausted. The patent is dated June 1, 1869. No. 90,646. It is for a vote recorder and indicator, and consists of a tablet or block with two rows of names connected with electric circuits in such a manner, that when anyone of



BRUSH DUPLEX LAMP—1879.

them is to be indicated, a current can be caused, by closing the proper circuit, to pass through it and a roller which passes over chemically prepared paper between them, thus leaving a mark. In addition there are two step by step indicators at the top of the instrument, one for yes and the other for no. Since this patent was granted, Edison's name has appeared on the register for every year, and in some of the volumes entire pages are required for his name alone.

In the multitude of applications before the Patent Office, scarcely any attention is paid to one invention, however marked its merits, over others. The reasons are obvious. Before this tribunal all inventors, at least, are equal. If their inventions are patentable, they get their patents; if they are not there is no distinction made on any account. Alexander Graham Bell's applications in 1876 and 1877, received no more attention than any others, and it is even said that when the firm which had prepared the first case was broken up, a member who had prepared the famous fifth claim, which stood fire so well, made no effort to retain the case. Two figures are selected from the illustrations in the early case. They need no explanation. The application in this case spent only three



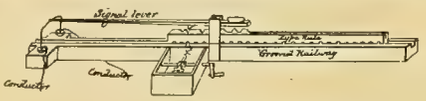
MORSE'S TELEGRAPH—1840.

weeks in the office, while the second patent, which has but recently expired, spent even less. In glancing at these, which to the public at large have been made more prominent perhaps than any other two patents ever issued, one cannot but be reminded of the line: "Imperial Caesar turned to clay," etc.

A very large proportion of the most important electrical patents have been issued in the last ten or fifteen years, and in fact over 90 per cent. of all the electrical patents have issued since the Centenial. The famous Brush double carbon arc lamp patent was dated September 2, 1879, No. 219,208. A selected figure is given below. This lamp employs ring clutches, for which, as covered by an earlier patent, Brush received large royalties until that patent was shown to be anticipated. These ring clutches, *c c*, are shown as held up by the lifter *D*, which in turn is operated by movable cores within the magnet helices *E E*. The operation is as follows:

When the current is not passing through the lamp the positive and negative carbons of each set, *a a*^{1} are in actual contact. When the current is passed through the lamp, the magnetic attraction of the helices *e* will operate to raise the lifter *D*. This lifter operating upon the clamps *C C*^{1}, tilts them and causes them to clamp and lift the carbon holders *B B*^{1}, and thus separate the carbons and produce the arc. It will be observed, however, that above the ring clutch *c* there is a weight *K*. This gives one side of the lifter *D* more work to do than the other, and consequently the carbons are not separated simultaneously. This is the gist of Brush's invention; the idea of causing the carbons to separate and burn dis-simultaneously.

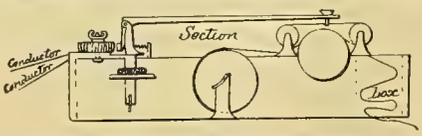
Just at present there could scarcely be a patent of more interest or of more importance than the Edison incandescent lamp patent of 1880. The recent Buckeye decision renders the instrument itself an interesting document. The illustration presented herewith is one of three, used to illustrate the invention, and the patent has four claims. Of these the first and second only are of importance. Attached to every printed copy of this patent are



MORSE'S TELEGRAPH TRANSMITTER—1840.

two slips, the first one given under the hand of the Commissioner of Patents Benj. Butterworth, December 18, 1883, and, purporting to be in compliance with the request of the party in interest, it limits by formal words the terms of the patent by that of one of several foreign patents, named, having the shortest term. The second slip is given under the hand of William E. Simonds, commissioner in 1893. It says:—"Now in compliance with the request of the parties in interest, said certificate is hereby cancelled." The question of estoppel, as raised by the Buckeye people, is an interesting one.

A patent which is of some interest, and perhaps of im-



MORSE'S TELEGRAPH RECEIVER—1840.

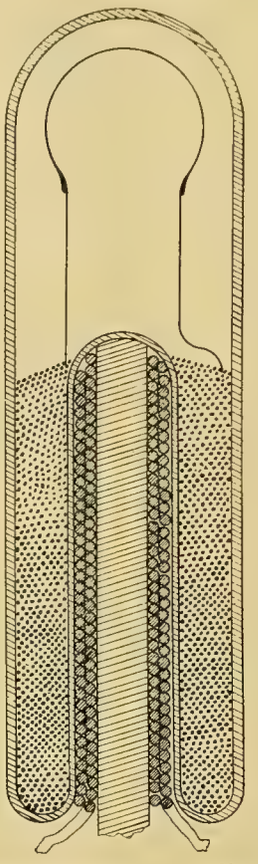
portance, as indicating a new departure, is that of Diehl, March 28, 1882, No. 255,497. If this lamp could be used it would most undoubtedly constitute a complete avoidance of the most liberal interpretation of Edison's claim. A secondary of the induction coil, as shown, is enclosed entirely within the glass globe, while the primary is a portion of the fixture or holder, over which the lamp is slipped.

In 1886, Thomson's welding process made its appearance in the office. His first patent, with broad claims, is numbered 347,140. It shows a simple mechanism for passing a current and at the same time exerting pressure on the parts to be welded. Like almost all important patents this one has a short specification and few claims.

The use of the step-down transformer for the working circuit where a high potential is used for transmission is broadly claimed by Gaulard and Gibbs, No. 351,589. The figure scarcely needs explanation. One of their broad claims is as follows:

In a system of electrical distribution a dynamo-electric machine organized for the production of alternating positive and negative currents equal to each other in potential and duration, in combination with the primary circuit of the inductorium or converter organized to induce in its secondary circuit alternating currents of lower potential and greater quantity than those of the primary circuit, and one or more translating devices actuated by said secondary currents.

There are four more very important patents which I wish to mention, but the list might be indefinitely extended, for of the 23,000 electrical patents, which have been issued, there are probably several thousand which would make interesting and profitable reading.



DIEHL INDUCTIVE LAMP—1882.

First of the four is Field's patent of 1889, No. 407,188, the second claim of which practically covers all underground conduit systems, except such as partake of the nature of Stetson's, and it might be even construed to cover those. The claim is for a motor propelled vehicle and a continuous hollow chamber containing an insulated electrical conductor, and provided with a longitudinal slot to permit of entrance of an arm projecting from said vehicle. This patent was issued from Division 26 and was assigned to the famous five Field brothers. The second of the four patents mentioned is that to Tesla for his inductive lamp having a single conducting wire, and is dated June 23, 1891, No. 454,622. The upper figure is a diagram of the system arranged in a room, the walls of which are supposed to be of conducting substance. As a record, alone, of an enormous stride forward in electrical theorizing, this patent is of the utmost importance.

Last, but very far indeed from being the least, are the Berliner and Edison patents, covering all known forms of microphone contacts, and owned by the Bell Telephone company. The Edison patent, No. 474,231 is absurdly brief, having less than one hundred and fifty lines of specification and but a single claim. One is enough, however, of that kind. It is as follows:

In a telegraphic apparatus operated by sound, the combination, with a diaphragm, of one or more contact points of plumbago or similar inferior conductor in the electric circuit, whereby the rise and fall of electric tension is proportionate to the pressure exerted upon the said point, or points by the diaphragm.

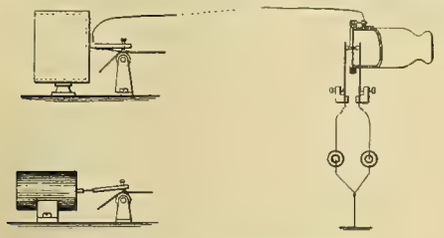
Berliner's application was filed five months after Bell's second patent issued and remained in the office almost as many years as that case did days. The most important figure of the patent is shown herewith and the most important claim is as follows:

The method of producing in a circuit electric undulations similar to sound waves by causing the sound waves to vary the pressure between electrodes in constant contact, so as to strengthen and weaken the contact and thereby increase and diminish the current in the circuit.

He describes the figure shown as a metal plate firmly fastened to the wooden box but able to vibrate to sound. Against each plate is a metal ball with adjusting means. It is supposed that in speaking against the diaphragm of the first instrument, it will cause electrical undulations by

he variations in pressure, and these electrical undulations, passing through the second contacts, will reproduce the sound vibrations of the diaphragm. This patent is one more example in which the broadest claims are founded on the simplest construction.

After reading this list of patents issued by the two electrical divisions, it will undoubtedly be conceded that the interests committed to them are not exceeded and

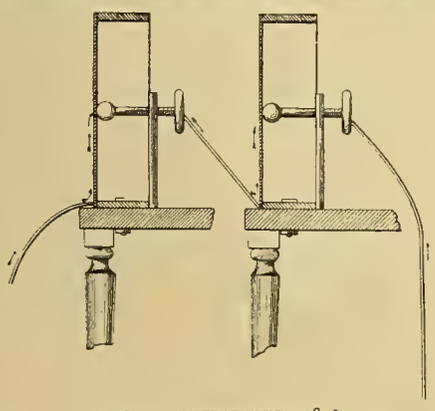


EDISON'S CARBON MICROPHONE—1892.

scarcely equalled in any of the other arts. In connection with this, it may be interesting to make a brief statement of the manner in which the work is done. Prior to 1880, the principal examiner in the philosophical division gave his personal attention to electrical matters, and to the present day, in both divisions, the principal examiner personally inspects and directs every action taken. When the applications are sent down to the divisions in the course of the regular routine for examination, they are placed on the desk of the examiner, who takes them up and allots them among his assistants. Of course, as indicated in another place, each assistant has a specialty, and in this way a considerable degree of expertness is acquired. It is to be regretted that the exigencies of the service (otherwise called smallness of the force), do not permit as extensive an examination as would be desirable. An inventor, who is a practical worker, makes himself acquainted with the resources and implements in use in his particular line. So far as he is concerned these represent the state of the art. But to the Patent Office the state of the art has a very different meaning. In addition to knowing the practical expedients of his profession, the examiner ought to know, or in examining an application, he is forced to find out the state of the art as disclosed by suggestions, previous patents, printed publications and every co-ordinate branch of the arts. This requires time, but it would be time well spent, if on taking his patent into court, the patentee or assignee could feel a reasonable certainty of its validity.

The amount of work done in the electrical divisions to the present time is as follows:

Up to June 30, 1892, 20,501 electrical patents had issued. The banner year during this time was 1890, with 2,354, but at the rate of increase observable 2,000 would be a fair average for the years to come and consequently adding 3,000 we have for the estimated number to January 1, 1894, 23,501 electrical patents. Of these 55 2 per cent., or considerably more than one-half have been granted since 1885, that is to say in the last eight years. The percentages of the total issue, in periods of five years, are shown by the dotted line on the accompanying



BERLINER MICROPHONE—1891.

diagram; the vertical divisions on the left being marked off in per cents, and on the rights in thousands. The percentages of the total issue are as follows:

From 1833 to 1842, less than one per cent.; from 1843 to 1879, between one and two per cent.; in 1879, two per cent.; 1880, four per cent.; 1881, five per cent.; 1882 to 1888, six per cent.; 1889, seven per cent.; and 1890, over nine per cent.

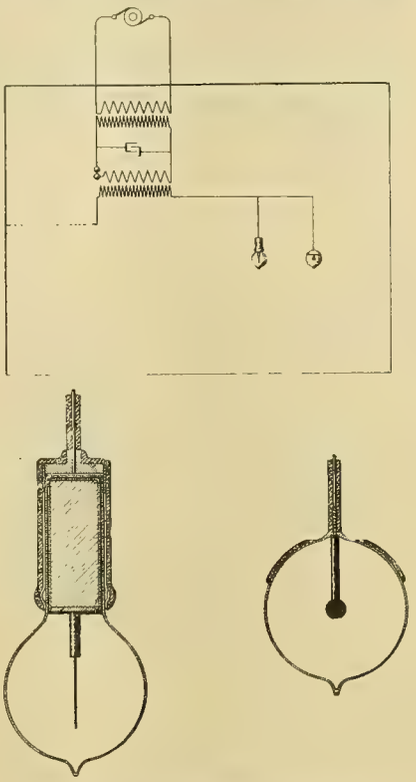
Of the amount of work at present going on in division 16, there were received during the year 1893, 1,335 applications; something like 82 per cent. of which were llowed. In division 26, there were received 1,193 applications, of which about 88 per cent. were allowed. The total number for the year for the two divisions was 2,528, which is at the rate of something over forty-eight per week. In using the above figures it must be remembered, that in the last two or three years a considerable number of applications have been sent to other divisions. Electrical devices and resources have now become sufficiently common to be considered in the light of adjuncts to the different arts and not as requiring separate examination by themselves, except where they are entirely electrical in their nature, like lamps and motors, and even they may ultimately be distributed to be examined in connection with the nearest art.

Notes of a Trip to the United States and to Chicago, 1893.

By W. H. Preece.

Part III.

Electric lighting has not generally made the rapid progress during the past nine years in the States that was expected from its great rate of growth during the previous four years. Wild speculation, hasty construction, fatal accidents and frequent failures have reacted on steady progress. At the same time the advance has been very



TESLA'S HIGH FREQUENCY LAMP—1891.

great, principally in public street lighting. All towns and villages in all parts of the country, however small and isolated, or however distant, seem to have adopted public arc lighting. Arc lamps are found suspended over the roadways in a very rough and-ready way, sometimes from stretched wires, sometimes from long balanced levers, but always effective.

The arc lamp posts are generally of timber, like telegraph poles; occasionally squared timber, as in Broadway, New York; and sometimes plain and neat iron poles, made of differing sections of iron pipes, but rarely so heavy, massive, artistic and expensive as in England. Clear glass globes appear to be almost universal in use. It is quite rare to see frosted glass or opaline shades.

The principal novelty introduced has been the use of flat carbons of oval or elliptic section, to increase the duration of the light. They are 310 millimeters long; the major axis is 25 millimeters, and the minor 11 millimeters. The ordinary arc lamp burns as a rule only eight hours, but this flat carbon doubles its life. Moreover, the flat carbon is found very advantageous and useful with alternating current systems, on which arc lamps as a rule work badly. The standard current used is 10 amperes, and the energy expended varies from 400 to 500 watts. The lamps burn very steadily as a rule, and give a light of about 800 candles at the angle of maximum intensity.

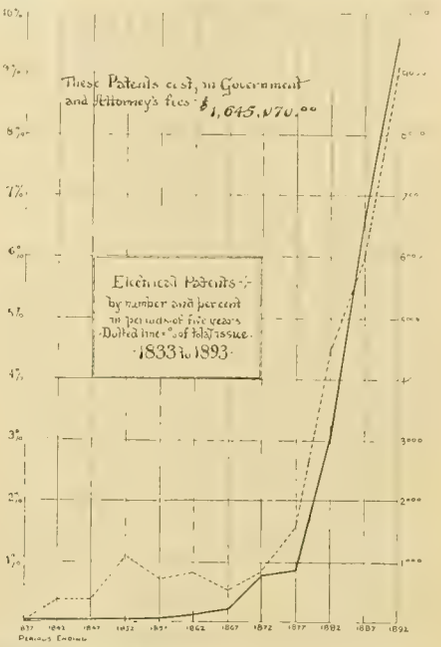
An excellent self-regulating alternator for public arc lighting, designed by Stanley, was exhibited by the Westinghouse company. It maintained its current quite constant, however much the number of the lamps was varied, between 0 and 24. Any number could be turned on or off without the least difference being detected in the current on the light.

Arc lighting is used very much for shop-lighting, not only in the interior for general illumination, but for advertising and attractive purposes outside. Indeed, many of the streets of the principal cities—especially New York and Chicago—are more brilliantly lighted by the shopkeepers than by the municipalities. In fact, in many cities there are many more arcs supplied for private than for public purposes.

INCANDESCENT LIGHTING.

Glow lamps are, within my observation, invariably used in telegraph offices, postoffices, telephone exchange rooms, hotels, and in many railway stations.

The electric light is more general in such public places than with us. I did not visit a single place that was not so fitted, and with glow lamps. In private houses it is



much used, but not so generally as with us. In Chicago the residential lighting is only 33 per cent. of the total. In all large cities there are immense blocks of buildings fitted with lifts and used as offices. In all cases they were lighted by their own isolated plants. One of the most striking features of a bird's-eye view from some lofty spot of a great city, like New York or Chicago, is the white, fleecy, wool-like jets of vapor that float gracefully away from the top of every large building. They are to be reckoned by the hundred, and everyone means steam plant working lifts and electric light. The Western Union company at New York and Chicago has its own steam plants.

When I visited Chicago in 1884 no central electric light-

Number of Electrical Patents by years ~ 1833 to 1892.

Year	No	Year	No.	Year	No.
1833	1	1854	16	1875	227
1834	1	1855	6	1876	113
1835	1	1856	15	1877	176
1836	–	1857	13	1878	222
1837	1	1858	43	1879	287
1838	2	1859	48	1880	550
1839	1	1860	32	1881	806
1840	3	1861	25	1882	1194
1841	2	1862	22	1883	1427
1842	1	1863	29	1884	1233
1843	2	1864	29	1885	1275
1844	–	1865	45	1886	1392
1845	4	1866	40	1887	1263
1846	4	1867	103	1888	1431
1847	–	1868	84	1889	1763
1848	8	1869	144	1890	2354
1849	11	1870	154	1891	2101
1850	11	1871	206	1892	1018
1851	–	1872	226	(This is to	
1852	18	1873	156	June 30	
1853	9	1874	163	1892)	

Total Government fees: $1,096,690.00
on Electricity, (1833-93) without copies or reissues.

ing station had been built and no current was supplied. Now a capital of $2,233,000 earns an income of $320,000 yearly.

The glow lamps (16 candle power) fixed are..136 4·9
Arc lamps fixed..... 4.376
Motors supplied—total horse power... 3,612

And this is equivalent to 430,000 10 candle power lamps fixed, or such lamps as we reckon with in England.

The maximum load is 50 per cent. of these lamps alight at one time, which accords with our experience in England.

The price works out at 7½d. per kilowatt-hour or supply unit, and this includes the cost of the renewal of the lamp. The cost of production works out at 3½ d. per unit. The cost of the production of electric energy in the

States differs, therefore, very little from that experienced here. It is everywhere steadily on the decrease. As the load increases, as the daily supply lengthens in duration, as the generators increase in size, so will the cost diminish; and how low it will fall no one can predictate. Anyway it will certainly far exceed in economy the production of gas.

The price of lamps to the undertaker—that is, to the electric light company—is 1s. 4d.; the life of the lamp is 600 hours. A 16 candle power lamp takes 0.45 amperes and 110 volts. It is, therefore, a 50 watt lamp, and a better one than we get at preseut in England. The screw socket appears to be in universal use. I wish it were so here.

There are three central stations in Chicago. A new station is being built alongside the water in Harrison street with a capacity for utilizing 20,000 horse power, where every modern appliance for cheap fuel, automatic feeding, condensing and economizing will be used.

The North Side central station is worked by natural gas, which is brought in pipes 100 miles from Indiana. It is very cheap compared with coal.

I found in use in Chicago a system of raising the voltage on the feeders when the pressure falls, owing to the increase of load, by switching in motor dynamos. They have given the name of "boosters" to these instruments. A somewhat similar system has been applied at home at the Midland railway, Derby.

The exhibition and its surroundings were, of course, brilliantly and entirely lighted by electricity.

The accumulator in America has been a failure for electric lighting, and a very strong prejudice exists against its use. It has led to much litigation, and the best forms seem little known there. The lagoons of the World's Fair grounds were, however, very successfully navigated by extremely pretty electric launches, worked and lighted by accumulators. The grounds at night, brilliantly illuminated and interlaced by winding waterways, with wooded islands and pretty bridges, along which illuminated gondolas and silent launches floated noiselessly, formed most beautiful and fairy-like scenes, superior to anything seen in Venice or pictured by art.

The feature that distinguishes American from English engineering practice is the persistent use of belting and countershafting. In some stations the belting was, to English eyes, appalling. Direct-driving is only now making its way. There was several direct-driven engines and dynamos exhibited in the American section at the World's Fair, and some new stations now being built, are to be direct-driven. The Willans & Robinson engines on show at the exhibition and a steam turbine exhibit in the Swedish section by Laval—a form somewhat similar to that of the Hon. Chas Parsons, who unfortunately did not exhibit—attracted much attention. The reports of our performances in England are much sought after, and I think one influence of the Chicago gathering will be to convert American engineers to direct-driving.

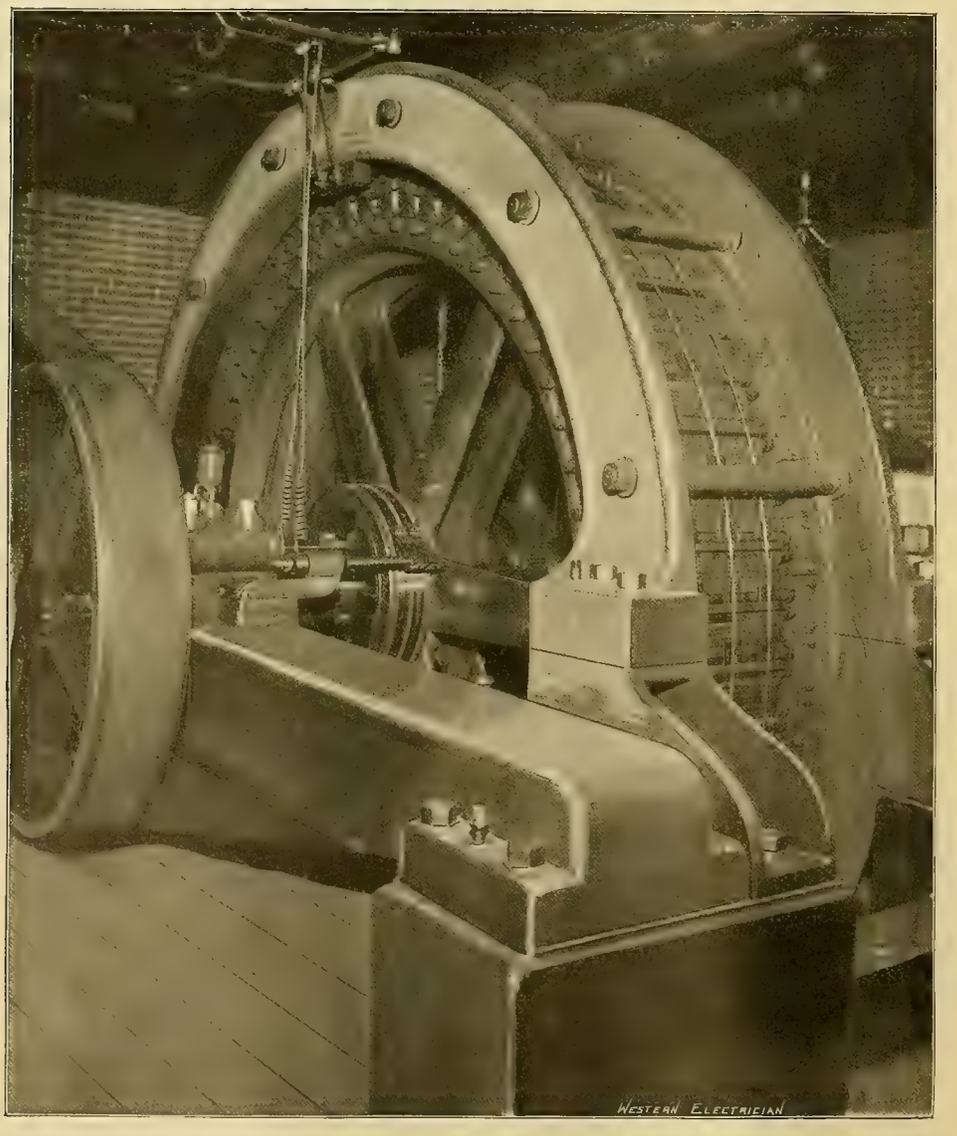


FIG. 2. NEW CENTRAL STATION PLANT IN CHICAGO.

The elastic character of direct-driving engines gradually increasing in number and capacity with the load, and the ability to shut down or turn on engine after engine, as the load varies, are economical advantages of immense value. The rapid regulation of small engines, the much smaller space occupied, where space is so valuable, the smaller capital expenditure involved, and the reduced working expenses, all give direct-driving an advantage, which should recommend itself to such eminently practical engineers as the Americans.

The General Electric company showed in the World's Fair a 1,000 horse power triple-expansion vertical marine type engine, driving two 400 kilowatt multipolar dynamos, and the Chicago Edison company is fitting up its new central station with such direct-driving engines. No one would continue to make huge dynamos with a speed of

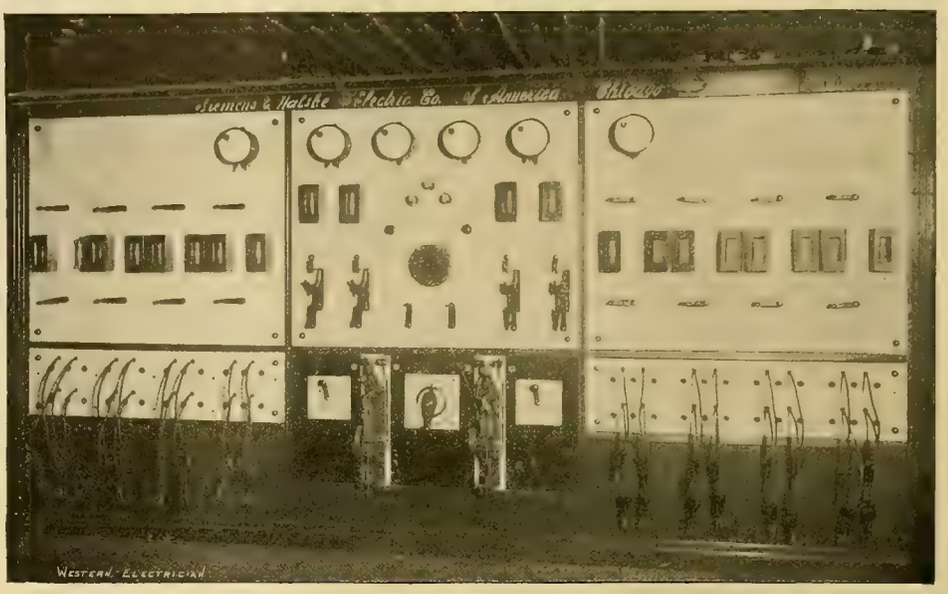


FIG. 4. NEW CENTRAL STATION PLANT IN CHICAGO.

90 revolutions per minute when convinced that smaller instruments of the same power may be run with equal economy and success at 350 revolutions per minute.

The town work at such places as New York, Boston and Chicago is as solid and substantial as anything we can show in England; but when we inspect the outlying works in country towns, we can only express our thanks that we have the control of the Board of Trade and the protection of an Act of Parliament. It is the fashion to decry grandmotherly government and to wince at departmental espionage; but the protection of life on our railways, the absence of accident in our electric light undertakings and the solid character of the work done everywhere, as compared with the same conditions in the States, can lead to but one conclusion—viz., that if, we are slower, we do these things at least better in England.

It is all very well in the pioneer stage of any industry to let private enterprise have its full swing, but when an industry becomes a public necessity, and when the interests of the whole comunity are at stake, government, as the custodian of the public weal, must step in and assume the control. The accidents in the States are terrible in their number and fatality; and they strike the observant Englishman with dismay. The value of life there seems to be very much below par.

ELECTRIC RAILWAYS.

The progress made in the establishment of electric railways is the most wonderful instance of growth of electric industry observable in the States. In 1884 I found only one railway so worked, and that experimentally, at Cleveland. Now every town has its electric railway. There are 4,000 miles of line so worked, 6,900 motor cars and 4,000 trailing cars [1] The capital embarked is $13,000,000, and the rate of progress is scarcely checked by the serious financial depression that has passed over the country.

Electrical appliances of all kinds for railway working were among the most conspicuous exhibits at the World's Fair. A special track was laid down for test and trial, and along here I inspected a 30 ton locomotive, the heaviest yet made, having a horizontal pull on the level of 6,000 pounds, or enough to draw 500 tons on an ordinary English railway.

The type of railway in general use over the United States of America is very uniform. We have only one true example in England, and that is at Leeds. A modification of the system has, however, been adopted on the South Staffordshire tramways, and is about to be introduced in Coventry. The wires are all overhead. A heavy insulated copper wire is suspended over the center of each pair of rails, or "track," and called the "trolley" wire. This conveys the current from the power house. It is picked up by a trolley rod, which presses, by the action of a spring, upon this wire, and so conveys the current to the motors, which are geared to each of the two wheel shafts of the car. The current is thence transmitted through the wheels to the rails, and it returns thence to the power house by heavy copper returns buried in the ground or suspended on the poles.

New Central Station Plant in Chicago.

The new central station plant in Chicago which has been under process of construction for the last year by the Siemens & Halske company of America was completed and turned over to the Co-operative Electric Light company last Thursday. A portion of the plant has been in operation for some time, supplying current for the North Side. This station is interesting not only because it is the

1. Trailing cars are not fitted with motors. They carry passengers only, and are drawn by motor cars.

first large commercial installation which the Siemens & Halske company has made in America and because it is a particularly well equipped and complete station, but because the largest alternator exhibited at the Frankfort Electrical Exhibition has been set up here, and is in daily operation. Over a year ago the Co-operative Electric Light company received a 20-year franchise from the city, permitting it to do electric lighting on the North Side. The Siemens & Halske alternating system was adopted, and the plant was located upon State street, near Elm street, in the basement of a large building.

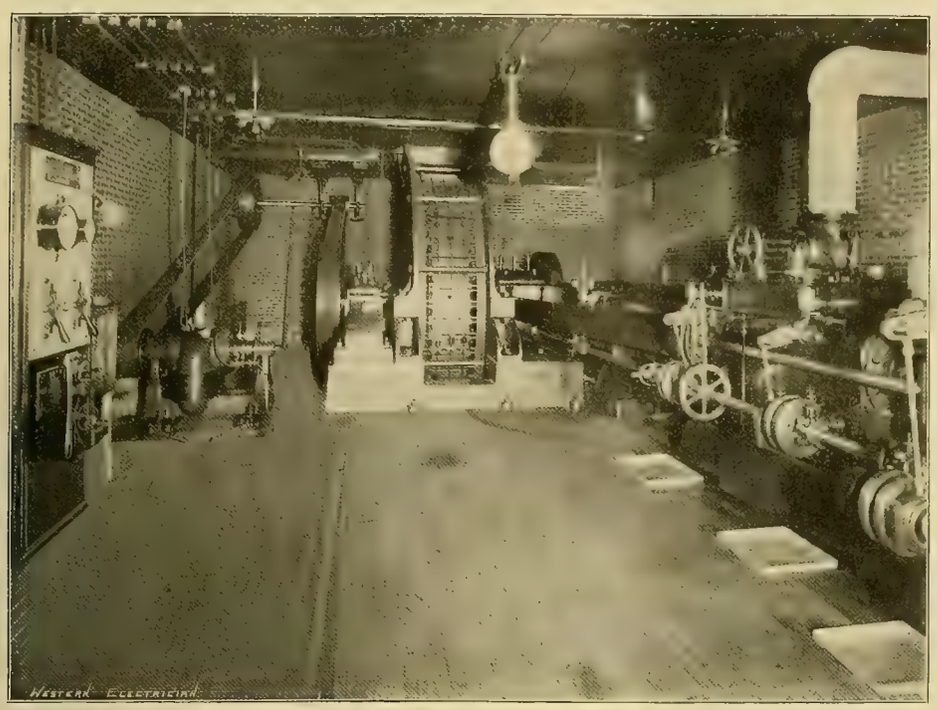


FIG. 1. NEW CENTRAL STATION PLANT IN CHICAGO.

The plant is divided into three parts, there being a boiler room and two dynamo rooms. In Fig. 3 is shown the room containing the main switchboard and two Siemens & Halske, type R dynamos of 50 kilowatts capacity each, wound for 2,000 volts, and belt driven by two Williams, tandem compound engines of 125 horse power capacity each, with 16 inch stroke. The high pressure cylinders are 9 inches in diameter and the low pressure cylinders 16 inches. The alternators are excited by two direct current dynamos of the Siemens & Halske, L. H. 4 type, wound for 50 volts at eight amperes, belt driven by a drum pulley, directly connected to the dymamos. The alternators are imported, and were originally three-phase machines, but were re-wound at the Chicago factory of the company for single-phase alternating work. They have fixed external armatures and revolving field magnets, the internal parts being protected by perforated cases. They make 1,125 revolutions a minute. The boiler plant consists of two, 300 horse power Stirling, type B, boilers, provided with Hawley down-draught furnaces and set in steel frames. The boiler capacity is at present insufficient for supplying the entire plant at the same time, and additions are contemplated. Water is obtained from an artesian well, 250 feet in depth, sunk on the premises, and provided with a Hooker deep water pump. The water is stored in a 4,000 gallon tank, on the roof of the building, about 80 feet above the floor of the engine room. Two smokestacks, each 125 feet high and 5 feet in diameter, have been erected. In the rear of the building is located the principal dynamo room, 28 by 54 by 11 feet, a view of which is presented in Fig. 1. In the farther end has been placed the large alternator, directly connected with an improved Greene, tandem compound, horizontal engine of 650 horse-power capacity, with cylinders, 19 by 30 by 48 feet. This large machine was operated at the Frankfort exhibition directly connected to a vertical, two cylinder, condensing engine of the Colman type, so that its appearance is much changed in most respects. For a foundation it has a block of concrete 10 feet deep and 22 feet wide. Under the dynamo is a riveted steel pan ¼ inch thick, 9 feet wide, 12 feet long and 6 feet deep, which can be entered by steps, thus giving access to the lower part of the armature and guarding against the entrance of water or moisture. This machine is of 350 kilowatts capacity and of the Siemens & Halske type Q, 185. The field magnet consists of 60 bobbins with laminated cores, built upon the rim of a fly wheel, 12 feet 4 inches in diameter over all; while the armature ring is 14 feet 9 inches in external diameter. It runs at 100 revolutions a minute, giving 165 amperes at 2,000 volts. The construction of the armature is as follows: A laminated ring of 60 segments, each built up of straight iron plates, stamped with end projections, is held together firmly in a cast-iron frame. Each segment before being put in place was wound with 20 turns of a conductor made of stranded copper wire compressed to a square section, each wire in the strand being lightly insulated with a coat of enamel. The ring is simply a laminated Pacinotti ring with sections coiled alternately right and left handedly. The laminated magnet cores carry 56 windings each, and receive a current of 56 amperes at 70 volts for excitation. The weight is about 100 tons complete. The shaft is 14½ inches in diameter at the engine bearings and 14 inches at the hub of the field magnets. A six-foot pulley drives a counter shaft, upon which is a 40-inch pulley, which is belted to the exciter, type L. H. 8, making 970 revolutions a minute. Fig. 2 gives an excellent idea of the alternator in detail. Current from the exciter is taken to a concentric brush-holder arm on the guide of the outboard bearing, and is transmitted thereon on a pair of rings on the hub of the fields to the field coils. Water is supplied by an Excelsior feed water heater and two Worthington boiler feed pumps. Drainage is provided for by a catch basin under the floor, from which water is pumped into the sewers, and ventilation is obtained by a Sturtevant blower run by a directly connected steam engine.

In the main dynamo room is a small marble switchboard containing main line switches, a rheostat, a carbon switch, voltmeter and ammeter. It is used in starting up the big alternator and is provided with dynamo switches for throwing it on the main switchboard in the other room.

The main board, which is shown in Fig. 4, is of white marble and is 7½ by 14⅓ feet. It is provided with a voltmeter, an ammeter, rheostat and carbon switch for each of the small alternators, and also with a rheostat in series with the rheostat on the small board, whereby the tension of the large alternator may be controlled at each board. The large board also contains a voltmeter showing the tension of the large machine, three sets of bus bars, one for each alternator. The eight out-going circuits are provided with switches, by means of which any circuit or group of circuits may be thrown on any machine, or transferred from one machine to another under tension. There are also twenty fuses of Siemens & Halske design, with the fuse strip enclosed in wood to prevent arcing. In the center of the board is a phase indicator connected with the small machines and switches for throwing the small machines in parallel, and a ground detector with a switch for throwing it into connection with any of the eight external circuits.

The carbon switch is in series with the exciter current and the fields of the alternators, and consists of a copper switch for closing the circuit and a pair of carbon points in shunt with the copper switch. The act of opening the copper switch throws into engagement a worm and gear connected with one of the two carbon points, and by rotating a small crank on a shaft of the worm, the carbon points are slowly drawn apart and take the spark from the self induction of the magnets. Upon closing the copper switch for use again, the worm is disengaged from the worm gear and the upper carbon point automatically drops into contact with the other point and the apparatus is in readiness for use again.

The voltage is transformed down from 2,000 to 100 at the points of distribution. The Elkhart type of converter is used principally in this installation. It is of the tooth type and has been giving excellent service. Roebling cable, lead covered with jute insulation, is laid in iron pipes, which lead to manholes, where are located water-proof fuse-boxes of Siemens & Halske construction. A number of alternating arc lamps of 1,200 candle power, enclosed in ornamented globes, are being run upon the incandescent circuits. A testing room, with the usual accessories, forms a portion of the installation.

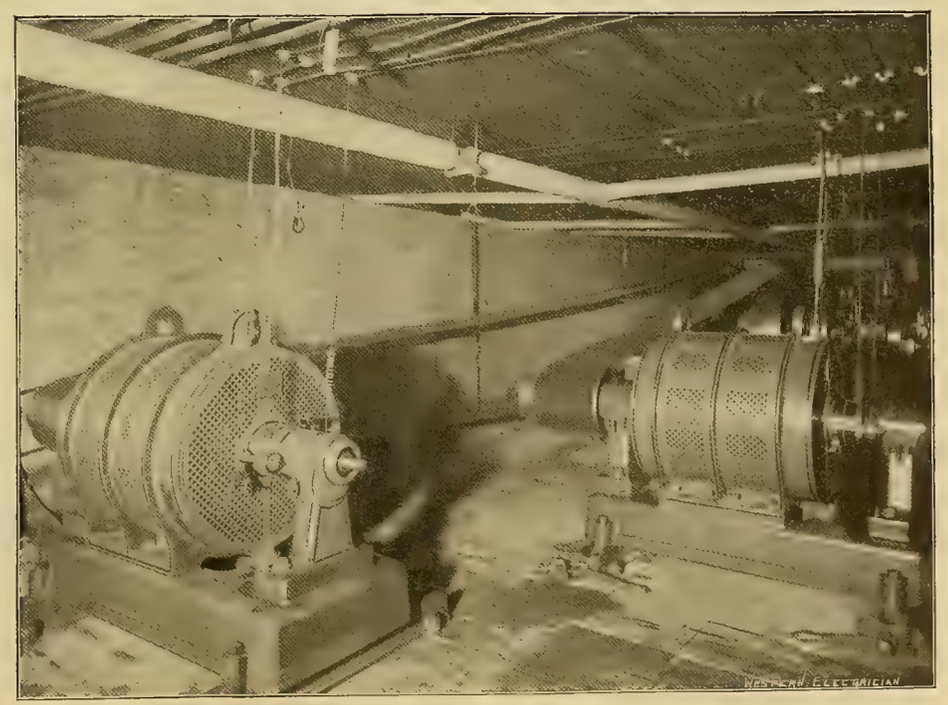


FIG. 3. NEW CENTRAL STATION PLANT IN CHICAGO.

The whole electric plant was planned and installed by William Buckingham, constructing electrical engineer of the Siemens & Halske company.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE London *Electrical Review* is devoting considerable attention to the study of American politics and public measures, and in this department it is becoming quite as well informed as some of the English dailies. In a recent issue it announced that "the Wilson tariff bill passed the House of Representatives," but it added that while there seemed little doubt that the measure would become a law, "it has yet to pass through the two Houses of Congress."

AN English electrical contemporary makes the statement that "There has been an unprecedented delay in announcing the awards made at the Chicago exhibition. No list of awards has yet been issued, and it seems quite uncertain when one will be. Many awards have been announced, but none have as yet been officially confirmed." This is incorrect. The list of awards in the department of electricity was published in the issues of the WESTERN ELECTRICIAN from September 30th to November 11th, inclusive. This list was a copy of the judges' findings, as posted in the office of the chief of the department, and is official. In all 224 awards were made in the electrical department.

MUCH disappointment is expressed over the report of the committee which made the official investigation into the Hermite process as applied at Havre. The report says that the process does not bring about a sufficiently rapid sterilization of sewage, and consequently does not constitute a sufficient guaranty for prompt disinfection, but as it shares with certain chemical products the property of deodorization it may, from that special point of view, and that only, have some hygienic value. When the experiments were begun there was much enthusiasm. It should be remembered that Havre drains its refuse into the gutters, and the condition of the town during the cholera epidemic in 1892 made it necessary for the authorities to take steps toward improving the sanitary condition of the city. Accordingly, Hermite's experiments were encouraged, and every facility was given the inventor to demonstrate the practicability of his system. It was claimed that when the water that conveyed the household slops and also the sewage from the closets had been charged with chlorine, there was not only an absence of bad odor but the gutters, always more or less black and soiled, were beautifully bleached. The curb and flagstones became white, as if they had just left the quarry. But the municipality was not content with these apparent merits, although the people generally applauded the success of M. Hermite's experiments. A technical committee was appointed, and its report, already alluded to, has been a great disappointment to all who had been favorably impressed with the Hermite process.

NEVER before in the history of the Patent Office has that department possessed so much interest for the electrical fraternity as at the present time. There have been many complaints against, and much dissatisfaction with, the management of the Patent Office, but there has never been any question as to the correctness of the underlying principle nor the value of the system in encouraging American progress. The electrical department has become one of the most important divisions in the Patent Office, not only on account of the rapid development of the industry and the consequent large increase in the number of patents issued yearly, but principally because of the great public importance and bearing these patents have upon the financial world. The necessity of having competent examiners, well equipped to examine and determine the technical questions that are constantly arising, has been repeatedly emphasized during the last few years. It is not at all singular that in the early days of the industry many patents were issued upon inventions that were not understood by the men who passed upon them. Out of the complications that resulted from this condition of affairs has developed the costly litigation which has occupied so much public attention and in many cases proved harmful to the industry generally. Every department of the industry has been affected—telegraphy, telephony, electric lighting and power. It is well, therefore, that these who are engaged in the industry should have some idea of the scope of the work that is being done in the Patent Office at Washington. In this issue an admirable sketch of the departments, its growth and the importance of the part which electricity and electrical patents occupy is presented. Many of the most notable cases that have come before the Patent Office in this line are briefly alluded to, and the student of statistics will find much to occupy his thoughts.

THE case of the Augusta Railway company against Glover, recently decided by the Supreme Court of Georgia, presents some rather unusual features of especial interest to street railway men. For instance, it was held that an electric railway company which has provided its cars with gates to prevent passengers from alighting on the side next to a parallel track cannot defend itself against the charge of negligence, in not keeping one of the gates closed, by the evidence of its president, "as to observations he had made in reference to electric street car lines, cable car lines, and other street car lines operating on double tracks, that he had made recently in various cities of the United States in reference to the use of gates on the cars, and to show that gates are not used." Street railway superintendents will also note with interest that, in this case the court also announced that there may be no negligence whatever in failing to have gates, for the very highest order of equipment may be dispensed with, provided the equipment is sufficient to come up to the standard of extraordinary diligence. This standard may be reached short of the very best or the superlative of the attainable. But, when a company has provided gates, due diligence might require it to use them, and failure to use them might be negligence in the given instance. This implies, of course, that if due diligence be used to insure the safety of passengers, it is not necessarily incumbent on the company to use the very latest type of protective apparatus. The precedent should be of considerable value in other damage suits.

A rather novel point brought up in this interesting case relates to the traveling experience of the injured passenger as bearing on the question of contributory negligence, and was decided in a manner unfavorable to the defendant company. The plaintiff brought suit to recover for the death of a passenger, who sustained a fatal injury in alighting. The court held that it was competent to show that the deceased had no previous experience in traveling upon an electric car, for the purpose, at least, of illustrating the cause of his failure to alight from the car in safety. The jury, it was said, in looking at the facts and circumstances of the homicide would naturally desire to classify the particular passenger, not alone by his age, but also by his experience, or the want of it, in handling himself as a passenger on electric cars. Familiarity with this mode of traveling would qualify him to see and appreciate danger which he would not be likely to observe if he were wholly without experience. With experience he might be chargeable with fault; without it, with none. And hence, in the one case his failure to come off safely might be attributable to his own negligence, in part or in whole, whereas, in the other case, he might be treated as free from any negligence whatever.

It would be interesting to know whether this principle is accepted as good law in other states. If so, it may become necessary for electric railway companies in small cities to open schools of instruction to teach the slow-going citizens the proper manner of getting on and off the cars of the new system. But it is not clear how, when a passenger presents himself and boards an electric car, the employes of the company are to judge whether he possesses the very slight degree of intelligence and experience necessary to enable him to stop the car and alight properly.

IN granting franchises for electric railways, boards of aldermen and councilmen should, of course, rigorously guard the interests of the people; but it is well to carefully examine the requirements of each particular case, with judgment and moderation, so that the desired permission will not be loaded down with unjust and unnecessary conditions that may make it impossible to operate the road successfully. It is particularly desirable to observe this principle of justice in small towns, where traffic is light. If the people desire rapid transit under such circumstances, they must, through their servants, the public officers, treat the proposed enterprise with fairness and forbearance, remembering that the company can only serve them if allowed to operate its plant in such a manner as to return a fair profit. The applicants for the franchise and the granters should consider the matter in an equitable spirit, with a due regard for the rights of all concerned.

A case has recently come under our observation in which this plain principle of fair dealing has been conspicuously disregarded, the electrical men being the sufferers. Marion, O., is a town of 10,000 inhabitants, and in response to a proposal to build an electric street railway the city council has passed an ordinance providing for such an improvement, it is true, but hedging the franchise with so many onerous restrictions that it is very improbable that the road will be built. Four miles of the railway must be built at once, and every detail of equipment is provided for on a scale of elaboration such as would be required for a railway in the residence district of a city like Chicago, except that single tracks are allowed on some streets. The poles must be of a uniform height, painted, and not one can be set until the location has been approved by the city authorities; 56 pound rails must be used; the company "shall not at any time or for any purpose make any opening or excavation whatever in any of the streets" except as provided by ordinances; the wires must be maintained "so as not to interfere with or in any manner obstruct the traffic" in the highways; the company must provide "new motor cars with the latest modern improvements for convenience and comfort" and must use "the best electrical and mechanical machinery for the propelling of cars"; in the central district the speed must not exceed three miles an hour; 25 tickets must be sold for $1; conductors and motormen must be provided with uniforms; free transportation is demanded not only for policemen and firemen but for "such other city officers as the council may request" and for letter carriers. The franchise is to run 25 years only, and the council reserves the right to make "such additional rules, regulations and requirements for the government of the person, firm or company owning or operating said railway as it may from time to time deem proper." It would seem that the last named requirement would hardly be necessary, but the councilmen seem to fear that there may be a possible restriction that they have missed. For a place like Marion, hardly more than a large village, the list of requirements is absurd, and we do not see how any reputable firm or company can afford to bid for the franchise extended. If the people of Marion want improved street railway service, they must instruct their representatives to come down to the earth from the clouds as gracefully as they may, and accept the practical street railway conditions found necessary in other small cities.

Hotel Normandie Electric Plant.

The Hotel Normandie, corner Fifteenth and I streets, N. W., was the first hotel in Washington to establish an isolated electric plant. Originally the plant consisted of one 600 light and one 250 light dynamo of the National make, run by a 9½ by 12 Beck engine at 300 revolutions. The plant was run from sunset until midnight only, gas supplying needed light during the remainder of the twenty-four hours.

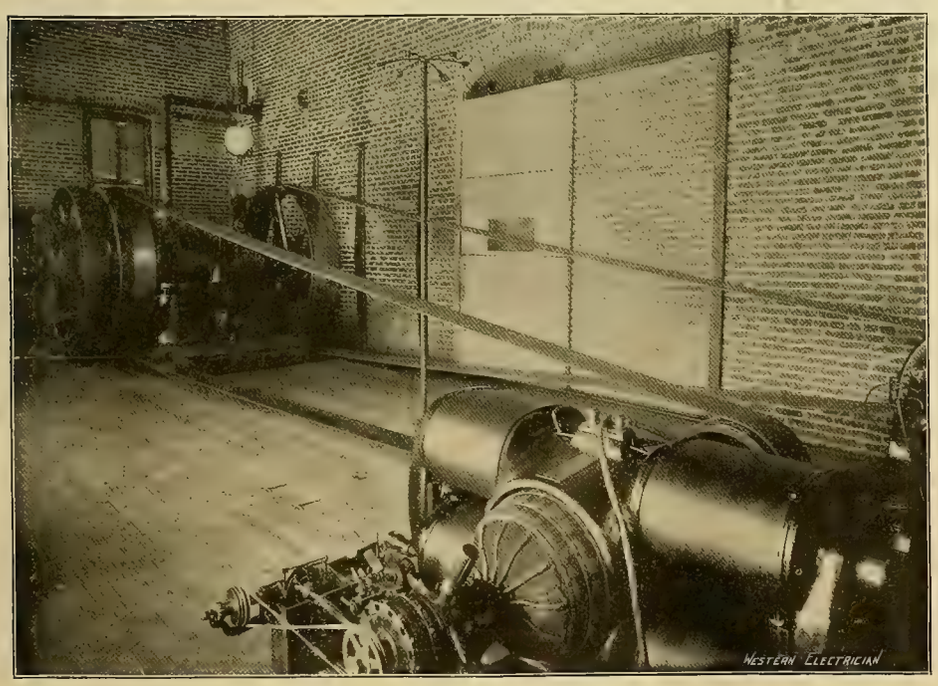
In November, 1892, the engineer, W. T. Stuart, changed the heating of the building from the use of live steam to that of exhaust from the engine and pumps. It was then seen that it would cost almost nothing to have electric light continuously during the time when heat was necessary for the building. The enterprising proprietor, Horace M. Cake, immediately authorized his engineer to put in a Buckeye engine, running 340 revolutions per minute, to light the hotel from midnight until sunset. The little Buckeye was coupled to the small dynamo early in January, 1893, and the hotel has been lighted by electricity continuously ever since without a break down.

During six months of 1893 the Buckeye was attached to the 600 light machine and developed from 5 to 35 horse power with the greatest economy.

The voltage originally used in this system was 100, but by the addition of various motors to meet the requirements of a first-class hotel, and also the use of arc lights to some extent, it was found necessary to increase the voltage to 110, which has been done gradually, although 100 volt lamps are still in use in the upper floors of the hotel. The plant being the first adopted in the city, it was found as time passed that many improvements were made in electric lighting and fixtures, but the proprietor has kept pace in the march of progress and has spared no pains or expense to make all necessary additions and improvements. To-day it is one of the best plants in the city, if judged by excellent continuous service.

Potomac Electric Company.

In the accompanying cut is presented a view of the dynamo room of the Potomac Electric company, of Georgetown, D. C. This company's station is located about three miles outside the city and the equipment consists of one Armington-Sims engine of 275 horse power, three Gordon boilers of 80 horse power each, one Gordon pump and two Davidson pumps. The electrical machinery consists of a 50 light Western Electric arc dynamo and a 1,250 light allernator of the Westinghouse type. The plant is operated under the supervision of M. O'Donnell, general manager of the company. The other officers are: President, J. C. O'Gorman; vice-president, G. W. Baird; secretary, N. Dumont; treasurer, H. P. Gilbert.



HOTEL NORMANDIE ELECTRIC PLANT.

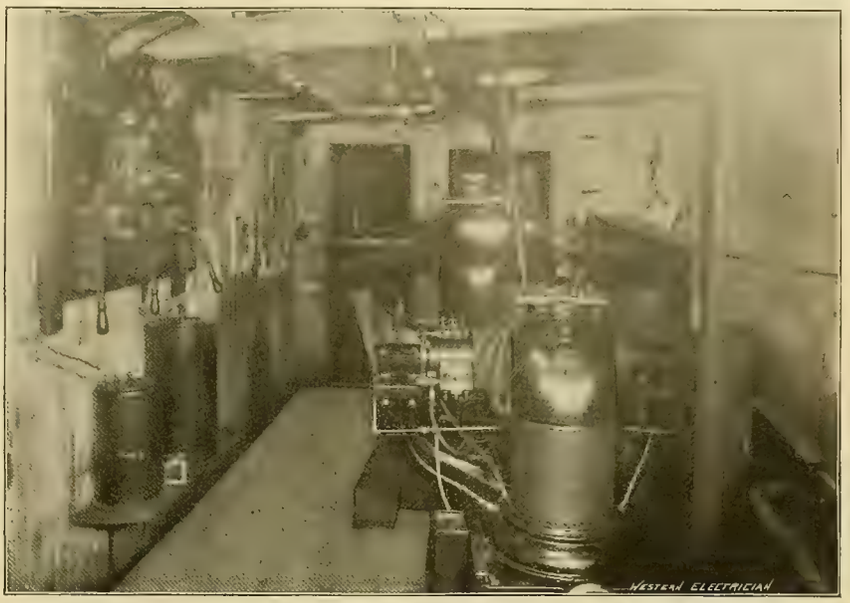
New York Electrical Society.

Joseph Sachs went into a very thorough exposition of the question of electric canal boat propulsion before the New York Electrical society at its last meeting, February 15th. Mr. Sachs' lecture was practically a discussion of the recent experiments on the Erie canal in all their bearings, a description of the various possible and feasible methods of electric canal boat propulsion for the canal and the outlining of an ideal system. The method which was tried on the canal near Rochester during the latter part of 1893 was first considered. Mr. Sachs maintained that while there was no doubt as to the feasibility of that system, there were several other methods of operating canal boats that deserved attention on the score of both efficiency and economy. These he divided into six classes, viz.: Propellers, flexible submerged cable towing, rigid rail towing or hauling (exterior), rigid rail towing or hauling (submerged), movable cable and motor locomotive haulage.

The special requirements for a successful system were summarized as follows: The deepening of the canal (with the present depth of hardly seven feet, the present maximum speed of two and one-half miles an hour can hardly be maintained, and a speed of not less than three miles an hour must be possible, as a minimum, to meet the demands of the traffic); that the methods of propulsion must not injure the canal structure; that it should appeal to the boatmen as a better and cheaper method; that the chances of break downs of propelling machinery must be minimized; that non-interference with the present methods of propulsion must be a feature; that the erection of structures of special strength and durability must be considered; that the system should entail the carrying of the minimum quantity of machinery upon the canal boat, and that the source of current supply shall be constant.

Of propellers, the lecturer said that the screw had been found the most feasible for canal boat propulsion. The three ways in which it was applied were: By placing the motor and screw directly upon the canal boat; by the use of separate propelling tugs that would carry no freight, and by the use of a false or detached stern, which holds the motor and screw.

The most advisable plan of applying the screw was undoubtedly the use of of a separate tug or false stern, by which the placing of the motor directly on the boat could be avoided. The principal drawbacks to ordinary propeller methods were low efficiency of screw propulsion and large operating expense, the necessity of equipping boats and motors, and injury to structure by wash.



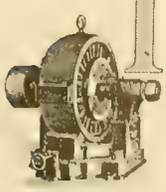
POTOMAC ELECTRIC COMPANY.—DYNAMO RCOM.

The submerged cable system is extensively used in Europe. It consists in laying at the bottom of the canal a chain or cable which is raised and passed over rollers or friction drums on the propelling or tow boat. A separate towing boat is used with a suitable engine and boiler and the necessary machinery for pulling on the cable or chain. This method was tried on the Erie canal, but unsuccessfully. The principal objections were the slipping of the chain, the large amount of slack chain each boat had to take up, and the necessity of dropping and taking up the cable at every one of the numerous locks on the canal. The electric motor could readily be substituted for the engine and boiler in such a system, and there would be no difficulty in the matter of supplying current, as instead of using two wires, one only would be necessary for each direction, as the cable could be used as the return. Possibly the separate towing boat could be dispensed with, as the motor takes up much less room than the engine and boiler; but it would be well to place the motor and machinery either directly on the boat or upon a detachable platform. The plans for pulling on the rigid rail, exterior and submerged, were regarded by the lecturer as presenting objections which militated seriously against their commercial success, and the moving cable system, similar that employed on cable roads, while it could be operated electrically, involved heavy losses in the transformations of energy, and was expensive and complicated.

Mr. Sachs then described the motor locomotive system—the actual substitution of an electric locomotive for the mule. Such locomotives would run along a track, and could be either large and heavy and run on a heavy and strong structure or track, or they could be small and run on a light structure, each motor being attached to a single boat and the motor on the structure regulated from the boat. The first method would necessitate the location of tracks on both sides of the canal, and besides being expensive, would interfere with the present methods. But in the latter method the lecturer saw the possibility of a solution of the electric canal boat propulsion problem. A light, strong and independent structure could be erected along the canal, supporting small electric motors, capable of being regulated from the boat, and it would possess the eminent advantage of not interfering with the present methods. Proper devices for the switching and passing of the boats, and for furnishing current and gripping the rail could be provided, and the motors for both directions could be operated on either bank of the canal or suspended overhead.

To operate 600 boats constantly moving on the Erie canal, 300 going each way, at three miles an hour in eight feet of water, and allowing 220 days of operation, the trolley propeller plant would cost $4,500,000, and the operating expenses would equal $800,000 for that time. To operate the same number of boats by the hauling method, the first cost of plant would be $5,550,000, and the cost of operation would be about $680,000.

Frederick A. La Roche and His Electrical Work.



IN the United States, as perhaps in no other country of the globe, energetic and intelligent effort to achieve legitimate business success or scientific prominence receives generous recognition and encouragement. Having to contend with little or no class distinction, the young American makes his start handicapped only by the conviction that there are, as there always will be, many hands reaching out for that rung "at the top of the ladder," where, someone has told him, there is still an abundance of "room." But although the top of the ladder, seen from its lowest rung, seems almost to vanish as it extends upward and many of the "rungs" appear already to be too heavily laden to bear additional weight, still the aspirant for success has consolation in the fact that but few of those at the upper end reached there without climbing rung by rung the same rickety ladder.

Mankind the world over stands ready to applaud a victor. In this country, where almost every man has to struggle for himself, the story of life's fight—perhaps successful, perhaps otherwise—be it of the millionaire philanthropist or the aspirant for the honors of the prize-ring, commands and holds the attention of the public. This is as true in commercial affairs as in any other department of human endeavor. The man, however, who carries on an old established business must need look to his grandfather or predecessor for the tale of the early struggles, and even then he but faintly grasps the full meaning of the word "pioneer." But how many who read the columns of the WESTERN ELECTRICIAN could tell a story of their own pioneering and work to the present time? How interesting such tales would be, and particularly so if all the happenings in "inner circles" during the last two years were recounted. In the running a few have fallen, some have recovered and again joined in the race, and others have kept steadily on until to-day a number of those concerns, starting several years ago in a modest way and laboring under many obstacles and difficulties, now find themselves in the foremost rank. It is the history of an enterprise entitled to rank in the class last named that commands our interest.

Fourteen years ago Frederick A. La Roche began in a small way the manufacture of laboratory instruments and dynamo-electric machinery, and to-day he holds the presidency of the La Roche Electric Works of Philadelphia, an establishment whose magnitude can better be appreciated after reference to the accompanying illustrations. The very fact of the humble start years ago lends additional interest to the recital of his electrical work. The facts of Mr. La Roche's early electrical experiences, as obtained from himself, are substantially as follows:

Frederick A. La Roche was born on October 4, 1859. At an early age he began to exhibit an aptness for mechanics that found vent in the manufacture of small steam engines, mechanical toys, etc. At the age of fourteen Mr. La Roche commenced a course of chemistry with Prof. Mathew of New York. Three years later he removed to Philadelphia and finished a course of civil and electrical engineering under Prof. Beck. A recital of many of his boyish ideas and experiments would afford considerable amusement, but through them all could be seen the talent and energy that finally enabled him to triumph. One project in particular on which his useful dreams of fortune were wrecked centered in an attempt to build a motor with permanent magnets wherein he used the current of several primary batteries to temporarily invert the poles of the magnets by sending around them a current opposed to their natural polarity. The experiment was a failure from an electrical point of view; nevertheless, from each failure young La Roche gleaned some valuable information that was stored in his brain for future use. Another example that met with a similar fate was an effort to combine storage and gas batteries in the same cell. The youthful experimenter made an iron vessel with a tight fitting lid, and provided the interior of the cell with the elements and compartments for the gases evolved during charging. This battery really gave three volts before it exploded, and this was the consoling thought that repaid him for the effort.

But the more serious work of Mr. La Roche's life commenced when, in 1880, he began in a small way the manufacture of laboratory instruments and dynamo machinery. These were his specialties, although "everything was grist that came to the mill." A good measure of success attended this venture and Mr. La Roche's work gave him such prominence that he was unanimously chosen as manager by the directors of the Electric Lighting company of Germantown, Pa. This plant was in so demoralized a condition that it had ceased to operate. With character

Brass Finishing Room. Machine and Blacksmith Shop — Exterior View. — Winding Field Magnets. Armature Room.

FIG. 2. FREDERICK A. LA ROCHE AND HIS ELECTRICAL WORK.—VIEWS OF THE FACTORY.

istic energy the new manager set about conquering the difficulties, and after much labor and painstaking care, he had the satisfaction of making the plant a first-class electrical and financial success. In an emergency Mr. La Roche showed that he had the useful faculty of doing the proper thing at the right time; he seemed almost intuitively to discern the cause of any trouble and to be ready with an expedient for its remedy.

Many interesting reminiscences might here be recorded of the experiences of Mr. La Roche while with this company, but it is sufficient to say that after two years in charge his progressive spirit, no longer content with the restricted field, urged him to launch out on a greater scale. Therefore, in 1887, he with several others associated themselves in a co-partnership for the manufacture of large dynamos and motors. This partnership was very short-lived, however, and it was dissolved in August of the same year. Thereupon Mr. La Roche immediately and upon his own responsibility founded the present well-known La Roche Electric Works of Philadelphia. The

first year or two witnessed a weary, disheartening struggle, but the cheerful, energetic spirit at the head of the enterprise knew no defeat, and to-day Mr. La Roche stands at the head of one of the most flourishing concerns in the country.

As an inventor Mr. La Roche has long been noted, and many are the useful contributions he has made in the line of electrical development. Some interesting examples may be cited. On one occassion his peculiar originality brought him into a controversy with the Patent Office. He had devised a new system for the distribution of electric current wherein he placed a dynamo at each end of the circuit, their like poles connected with a view of performing all work between the generators. The application for a patent on this discovery at first met with a positive refusal on the grounds that the invention was without merit and because it was directly opposed to well established laws of electrical science. This decision was finally reversed, when, after a practical illustration, Mr. La Roche not only proved the practicability of his invention but demonstrated that this method furnished an economical, equable distribution of current and that the potential remained the same throughout the circuit. This system has been successfully employed for a number of years for incandescent lighting. Mr. La Roche was the first to suggest two filaments in the same lamp, one of high and the other of low resistance, the object being to secure a dim as well as a bright light by simply turning the key and switching the current from one filament to the other. A similar end he accomplished also by secreting a resistance bobbin within the socket of a lamp, so that the light could be regulated with the same facility as gas. Carbon brushes for dynamos and motors formed the basis of early experiment with him, and such good results were obtained that he devised and patented a peculiar holder for the carbons. With this combination sparking at the brushes and wear of the commutator were practically eliminated.

Mr. La Roche has for several years given special attention to alternating current machinery. The very excellent alternating system of this company is the result of his labor as well as some five or six other systems that are now owned and operated by this company. The resolute, determined manner with which he attacks the solution of a problem generally insures its satisfactory determination. Nothing seems to daunt him, from the requirements of the most delicate, accurate instrument work to the building of a 10,000 light dynamo, and he supervises the manufacture of everything between these extremes. As manager of an electrical manufacturing company Mr. La Roche's talents are conspicuously exemplified. Of late years Mr. La Roche's business has grown rapidly and his apparatus to-day is considered as standard throughout the country, being used in a great many colleges, laboratories and scientific schools. The founder of the company has surrounded himself with a capable staff of assistants, whose portraits are shown about the likeness of Mr. La Roche in Fig. 1.

J Frank Stevens, the secretary and treasurer of the company, was elected to the position he now holds by the directors last November. Mr. Stevens is a graduate of the University of Pennsylvania, having taken a degree in mechanical and electrical engineering. He was formerly a member of the firm of John S. Stevens & Sons, where he obtained his practical and financial training. His services are extremely valuable to the company, which feels that it has made a wise selection.

George S. Loutey is the superintendent of construction and installation. He has been employed by the company about eight years, and is greatly esteemed by the officers for his faithfulness and loyalty.

William G. Toplis, the chemist, has been associated with Mr. La Roche for twelve years. It is unnecessary to say much regarding his reputation as a first class chemist; the fact has long been recognized. Mr. Toplis has contributed a number of inventions to the government.

J. W. W. Cornman, a graduate of the Manual Training School, has charge of the instrument department. He is well known in the instrument business, having been in the employment of Queen & Co. There is no doubt that the instrument department will be greatly benefited by this valuable acquisition.

George W. Bacon and Frank R. Ford are members of the engineering staff. The former is a graduate of Cornell University, having taken degrees in mechanical and electrical engineering, and was formerly with the Wightman Motor company of Scranton, Pa. Mr. Ford graduated from the University of Pennsylvania, and was formerly with the Short Electric company of Cleveland, O., having charge of the Chicago office. He now has charge of the railway department of the La Roche Electric Works.

Gurney F. Coleman, who has had an extensive experience in the installation of isolated and central station plants, is now associated with the La Roche company in that capacity. His extensive experience has made him well fitted for the position. Mr. Coleman is also a graduate of the University of Pennsylvania.

C. J. Miller, assistant superintendent of the works, was formerly with the Novelty Electric company. He attends to the details of the manufacture of the apparatus under the direction of Mr. La Roche.

The La Roche Electric Works were started in a room eight feet square with a small foot lathe and one mechanic (Mr. La Roche himself). Business prospered, and an addition was made in the shape of a boy, and business still increasing a "one-half" mechanic was engaged and afterward another boy. The demand for small dynamos being considerable, the whole of the second floor was then taken and about one year afterward the third floor of the same building. Still finding it necessary to have more room, the building at 116 North Sixth street was rented and three floors used, and a short time after that the entire building was used. The business still continued to grow; new machinery was purchased from time to time and more men put on Finally the building became too small for the work, and the building at No. 118 was then rented and doors cut through, and the company continued there for nearly three years. Such was the demand for the La Roche apparatus, especially for large machines, that Mr. La Roche incorporated the business into a stock company, which subsequently purchased the property now occupied at American and Diamond streets. The factory is fully equipped with all modern machinery, apparatus etc., so that any machine up to 5,000 lights or 500 horse power can be handled. The building faces three streets —American, Diamond and Bodine—and on the north side there is considerable ground to enlarge if necessary. It is seven stories high with a frontage on Diamond street of 120 feet and on Bodine street of 116 feet. It is substantially built with 30-inch walls, thoroughly braced floors, etc. A series of exterior and interior views is shown in Figs. 2, 3 and 4.

The power plant comprises three 125 horse power engines and one 25 horse power engine. One of the larger engines drives two direct current generators, one alternator and an arc light machine. The direct current generators furnish power throughout the establishment, as all the departments are run with individual motors, no belts of any kind passing through the floors. Where there are grouped a number of machine tools a small countershaft is placed above driven by an electric motor. The small 25 horse power engine is used for lighting the office, etc., after 6 P. M., when the main plant is shut down, provided the factory is not in operation. The two remaining engines are employed for testing the apparatus and are so arranged that any one, or the combined power of three, can be concentrated upon one generator. There are in all four boilers of 125 horse power each, of which one is used for heating the building and the remaining three for power purposes.

1. F. A. La Roche.
2. J. Frank Stevens.
3. George S. Loutey.
4. William G. Toplis.
5. J. W. W. Cornman.
6. George W. Bacon.
7. Frank R. Ford.
8. Gurney F. Coleman.
9. C. J. Miller.

FIG. 1. FREDERICK A LA ROCHE AND HIS ELECTRICAL WORK —EXECUTIVE STAFF OF THE LA ROCHE ELECTRIC WORKS.

On the ground floor is also located the blacksmith shop, where all the heavy machine work is done. There is also considerable heavy brass work done on this floor, as some of the brass spiders and shields used in the 5,000 light alternators are turned up and finished in this department, as extra large lathes and tools are required to handle these large diameters. This department is well equipped with new, large and modern machinery. On the same floor, one of the planers, as shown in Fig. 3, is run by individual motors.

The erecting, assembling and testing room, where there are a number of large and small direct current machines and alternators in the course of construction, is on the second floor. The stock room is also located on this floor In this room is a large stamping press, where the armature disks are cut and stamped, insulated and assembled. The alternator armatures are of novel and ingenious construction and are so arranged that any num-

ber of coils up to one-half the total number may be burnt out or affected by any other cause without interfering with the machine running at full load, and in case of such an accident repairs can be made in a very short time. A toothed armature is used for all alternators of 500 lights capacity or over and a smooth armature for all under that size. The armatures are of the laminated type, made of the best Norway iron, insulated with specially prepared paper. On the 2,600 light machine the armature is bolted together with 27 bolts. The armature grooves are of a new design and exceedingly shallow, insulated with asbestos and the best grade of mica, making them practically fire and water proof. There are no complications of any kind about the entire apparatus; it is exceedingly simple, and can be run and handled with impunity. The armature is mounted upon an extra heavy steel shaft ground to gauge. It is absolutely iron-clad and no wire is shown when completed. It will be noticed that in this machine the frame or ring is cast in two separate parts so arranged that the top half can be removed and any field coil placed or replaced. Another advantage claimed by the manufacturers is that it is not necessary to remove the armature or any portion of the machine to insert a new coil, as that can be done without removing any part or parts. The end of the armature is protected by a brass shield, which is carefully insulated, and where leading-in wires are cut through it is insulated with micanite and hard rubber bushings. The collector rings are mounted upon an individual sleeve and arranged so that either one or both rings can be removed in a short time. All machines are equipped with ball and socket self-oiling bearings. Although the company has been more recently occupied with alternating machinery, it nevertheless continues to manufacture direct current apparatus. It is now making power generators ranging in size from 50 to 300 horse power. All generators of 100 horse power and under are built on the motor bipolar type. The generators over 100 horse power are made on the multipolar type with circular fields similar to the alternating machines. The direct current machine is one of the most automatic on the market, the method of regulation being new and different from the ordinary method. All direct current machines have Gramme ring armatures, and the company from the beginning designed its machines with armatures having the greatest dimension in their diameters. It is evident that this construction permits of a machine of the same output being run at much less speed than when the armature is reduced in diameter and increased in length, a practice quite generally followed. It may be stated here that the La Roche company was among the first in this country making alternating apparatus.

On the third floor is the brass finishing room, which is well equipped with modern machinery. On this floor also is the armature and field winding department, where armatures and fields of both direct and alternating apparatus are separately wound on frames or spools and slipped on machines when completed. A stock of coils is kept constantly on hand. In this room there are a number of smooth and toothed armatures in course of construction. In the usual method of winding both fields and armatures, the winding is begun at one end of the wire and carried out continuously, the other end being finally made to cross the convolutions in order to be brought out parallel with the other end; this subjects the crossing end to the maximum difference of potential on the entire coil and is a frequent cause of burn-outs and short-circuits due to the inevitable vibration which takes place and consequently damage to insulation. In the method pursued by Mr. La Roche the winding is begun in the middle of the wire, both ends being wound at the same time, and when the wire is finished the two ends come out opposite each other at the center of the coil without crossing any convolution whatever. This method brings the least insulation strain on the wire, and the breaking or burning of one end does not require the entire rewinding of the coil.

Recognizing the value of accurate and reliable indicating instruments in isolated as well as central station work, the La Roche company almost from the beginning has built the indicating instruments with which its plants have been equipped. These instruments consist of a voltmeter, potential indicator, ammeter indicator and ampere meter. These instruments are handsomely gotten up, enclosed in a brass case having either back or surface connections and make a very neat appearance on the switchboard.

The fifth floor is used for a wood-working, pattern making and packing room, while the sixth floor is utilized for storage purposes. All the floors are connected by an elevator operated by means of an electric motor.

Mr. LaRoche claims to be the first man to make a successful automatic, cut-off, constant current motor. When Prof. Maxim came to this country and started to manufacture in Philadelphia what was known as a Maxim machine, Mr. LaRoche, who was quite young at that time, brought a motor to the professor asking him to test it on a circuit. The professor answered that no motor could be made that would stand the pressure. He finally put it on the circuit, but it heated to a considerable extent, although after rewinding it was found to work nicely. From that time on Mr. LaRoche made a specialty of building both constant current and constant potential motors and up to the present time there are quite a number of LaRoche constant current motors on the Brush circuit in Philadelphia. The La Roche company has been running its works

General Office. Mr. La Roche's Office. Testing Laboratory.
Lathe Driven by Motor. Planer Driven by Motor.

FIG. 3. FREDERICK A LA ROCHE AND HIS ELECTRICAL WORK.—OFFICE AND FACTORY GLIMPSES.

General Testing Room. Pattern and Carpenter Shop. Assembling Room.
Engine Room.

FIG. 4. FREDERICK A. LA ROCHE AND HIS ELECTRICAL WORK.—FOUR IMPORTANT DEPARTMENTS.

for the past six months, day and night, working on large alternating machines. It has recently installed several 2,600 light machines, and quite a number of 1,300 light alternators, two of them for the Quincy Electric Light & Power company, Quincy, Mass, The company operates under patents granted to F. A. La Roche, and which are owned by the company. It is making a special line of alternating current machinery, also direct current machinery

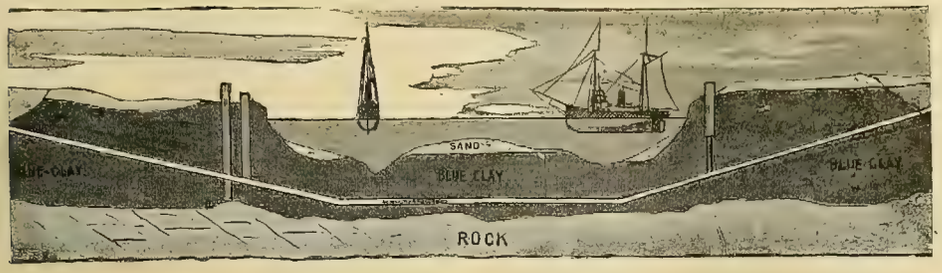
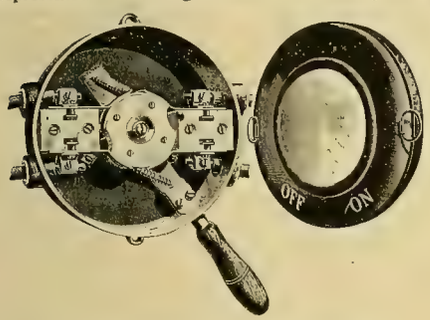


FIG. 2. KERITE UNDER LAKE HURON.

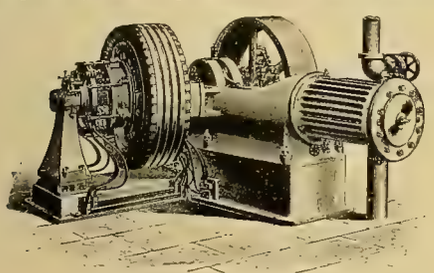
for incandescent lighting, power generators, railway motors, arc lighting aparatus; in fact electrical machinery of every description. The company is also about to put on the market a special line of direct-connected apparatus, which if it comes up to the high standard which has been established, cannot fail to be a success. It is also making a complete line of switchboard apparatus. The company is represented in the large cities of the country as follows: Chicago, Hood & Osburn, 239 La Salle street; New York, W. A. Vail, 136 Liberty street; St. Louis, Owen Ford, Rialto building; Boston, Campbell Electrical Supply company, 104 High street; San Francisco, San Francisco Electric company; Knoxville, Tenn., Southern Brass & Iron company.



BRYANT-CLEVELAND ARC LIGHT CUT-OUT.

Bryant-Cleveland Arc Light Cut-out.

The accompanying cut shows a new arc light cut-out. The Bryant Electric company, Bridgeport, Conn., which purchased the patents of the Cleveland arc light cut-out has developed, and modified its construction, and is placing this new cut-out on the market. The cut-out is made of metal, porcelain and glass. The connections are of the K. W. pattern. The action of the cut-out is quick and positive, and the position of the handle indicates whether the current is off or on. The cap is of light metal with a glass permitting the mechanism of the cut-out to be always in full view. It can also be easily removed so as to give free access to the interior of the switch. The western office of the company is located at 1522 Monadnock building, Chicago.



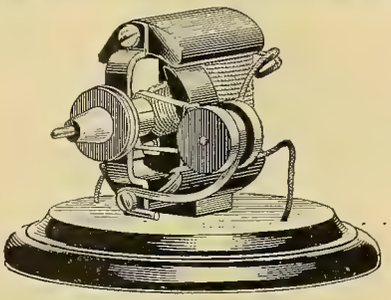
BALL DIRECTLY CONNECTED ENGINE.

Ball Directly Connected Engine.

The direct connection of engine and dynamo has a twofold advantage: The first of these is the small floor space occupied. Another advantage is in the elimination of wastes of energy by transmission through belts and counter-shafting. The accompanying illustration represents an 80 horse power Ball engine, made by the Ball Engine company, Erie, Pa., directly connected to a Waddell-Entz dynamo. It shows the armature mounted on the engine crank shaft, which is supported on the end by an outboard bearing resting on an extended sub-base. This is a remarkably compact, durable and efficient arrangement, and has given the greatest satisfaction in practice. The distinctive features of this engine are: Carefulness of design, simplicity and compactness, solidity and strength of frame, large bearings and wearing surfaces, excellence of materials and workmanship. The engine is economical and durable, and being so perfectly balanced, will run quietly and smoothly under the heaviest and widest varying loads. Every detail of construction receives the most careful inspection, and every engine is thoroughly tested before shipment is made.

New Bergmann Alternating Arc Lamp.

One of the distinctive features of the electric lighting industry during the last year has been the marked increase of interest in the subject of arc lighting on alternating current circuits by means of the so-called incandescent arc lamp. The new Bergmann alternating current lamp now being put on the market by the General Incandescent Arc Light company of New York is a lamp of this character.



SMALL MOTOR OUTFIT.

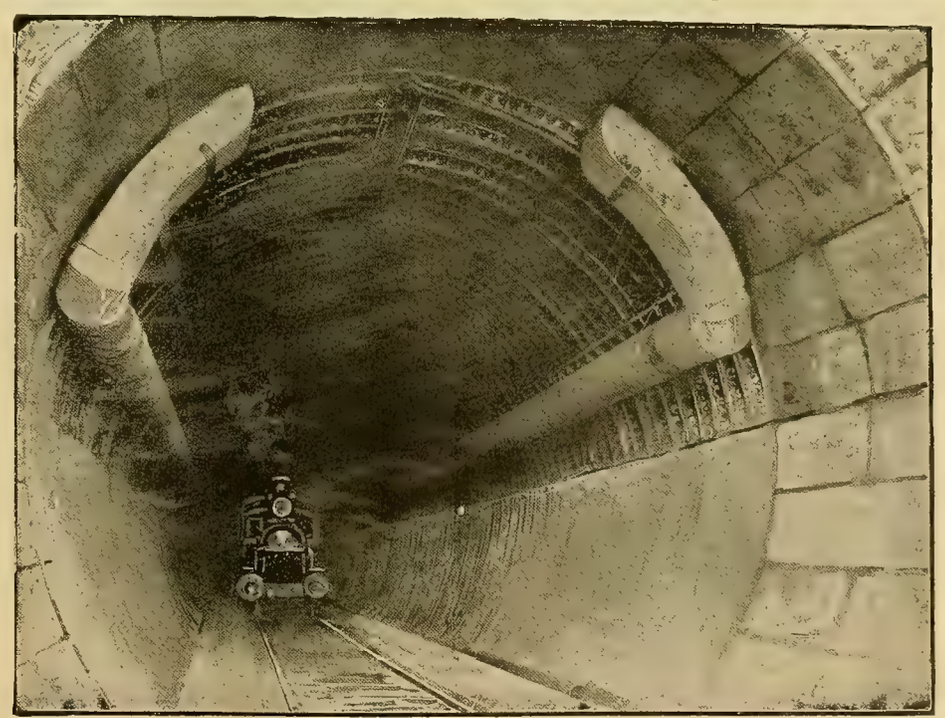
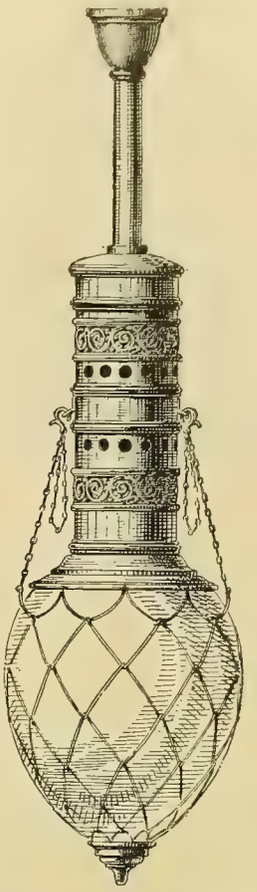


FIG. 1. KERITE UNDER LAKE HURON.

As in the case of its direct current lamp, this company manufactures its alternating current incandescent arc lamps in various styles and degrees of ornamentation, from the plainest standard lamp, which is itself sightly in appearance and neat in design, to the most elaborate patterns. In the accompanying cut is shown a representative type. Some of the claims which are made for these lamps are simplicity of mechanism, first-class workmanship, absolute steadiness without adjustments, ease of trimming, protection from dust and weather, starting at less than the normal current, requiring on waste of current in resistance, large range of candle power, improved carbon-holders, etc.

The company is prepared to send the lamp on trial to any responsible intending purchaser, and anticipates a rush of orders after the convention as a result of the exhibition it intends to make there. The company will be represented at the convention by its general sales agent, S. A. Douglas, who will be pleased to go into the details and show all the excellent qualities and points of merit of this incandescent arc lamp to those who will be present at this meeting of the various electric light interests.



NEW BERGMANN ALTERNATING ARC LAMP.

Kerite Under Lake Huron.

Engineers watched with considerable interest the construction of the great St. Clair tunnel, which was built under the foot of Lake Huron, between Sarnia, Ont., and Port Huron, Mich., and by means of which the water passage across the Straits of St. Clair at the lower end of Lake Huron is avoided, and a continuous journey by rail

between the United States and Canada can be made. The tunnel is now in full operation and is used by the Grand Trunk for both passenger and freight service. Electrical men in this country were much interested in the successful operation of the tunnel, as their products were largely used in its construction, and it is interesting to note that the lighting was done by the Edison company on the American side, supplemented by the Ball Electric Light company of Canada. Packing for the cast iron segments of the tunnel was of the P. & B. make, furnished by the Standard Paint company; Root blowers were supplied for

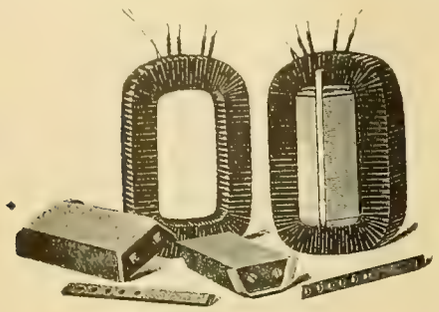


FIG. 1. ELKHART TRANSFORMER.

ventilation, and in Fig. 1 is shown the runs of piping made and installed by the Abendroth & Root Manufacturing company of New York. But perhaps the part of the enterprise most interesting to electrical engineers was that carried out by W. R. Brixey, the manufacturer of Day's Kerite wires and cables. That part was the making of 6,000 feet of 18 conductor aerial cable by Mr. Brixey for use in the tunnel, for the Great Northwestern Telegraph company. The test is a most severe one, as the cables are incessantly subjected to the deteriorating influences of steam, smoke, soot, etc. The telegraph company has, however, recently reported to Mr. Brixey on this cable in high terms of praise. From Fig. 2 may be gained an idea of the magnitude and importance of the work. The tunnel itself is an iron tube 19 feet 10 inches in diameter, and 6,025 feet in length. Added to this is 5,063 feet of portal and approaches, making about a little more than two miles.

Elkhart Transformer.

The Elkhart transformers, manufactured by the Hornberger Electric Manufacturing company, Elkhart, Ind., possess many points of merit which have contributed to the success of their introduction and operation. The converter is of the tooth type, and one of its principal claims for attention is that the coil may be removed, inspected and replaced in a very short space of time without destroying the integrity of the laminations of the iron.

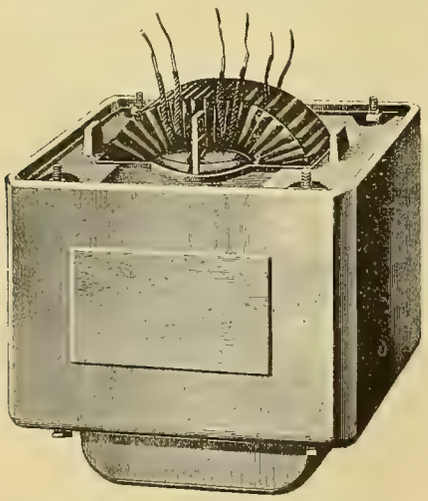


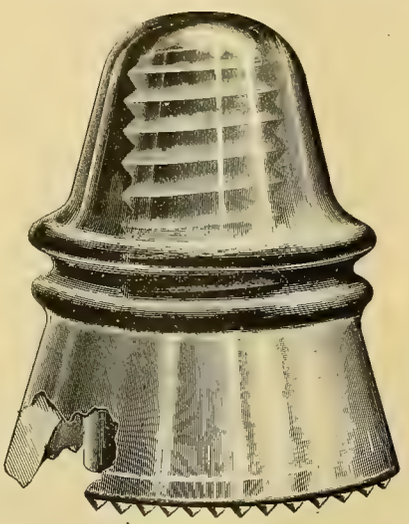
FIG. 2. ELKHART TRANSFORMER.

All the coils are interchangeable, and by having an extra coil at hand repairs may be made in an extremely short time. In Fig. 1 is shown the parts of the transformer, and in Fig. 2 the appearance of the box ready for service. In the mechanical construction of the converter the outer magnetic circuit is unbroken, the laminæ are placed in the case under hydraulic pressure, thus making them practically noiseless. The core pieces when placed in position occupy the V shape cut in the outer laminæ, and by means of the wedges the magnetic resistance is reduced to a minimum by practically making each lamination one piece of iron.

In the coil construction a compound having high insulating qualities is used, rendering the complete coil practically indestructible and impervious to moisture; the whole constituting a solid mass of wire and insulating compound of an inseparable nature. The Elkhart transformer is covered by broad patents. The company gives special inducements to secure a fair trial of its specialty.

Clark Arc Lamp for Alternating Currents.

The Clark Electric company, New York, was one of the first to recognize the demand for better, more reliable and steadier arc lighting for commercial use. While the street lighting had been developed rapidly, there was a continued complaint from merchants of all kinds, on account of the arc lighting being unsteady, noisy and unreliable. This company set out to make the best grade of arc lighting apparatus, and especially arc lamps for use on every current. That being the objective point from the beginning, it has been pursued persistently, and the company's success has been marked. It has been the company's custom to watch the legitimate demand for arc lighting, and be prepared to meet it, and one of the latest accomplishments in this direction is an arc lamp for alternating currents, which, the company asserts, has met all requirements. The alternating arc lamp is made to run singly or in series in any number, according to the potential, supplying thirty volts for each lamp. The lamp has differential action, and is supplied with an automatic cut-out, which makes it perfectly practical to trim the lamps without turning more than one off, or the number that is being trimmed; in fact, it makes them the same as a constant current arc lamp. These lamps are made for use for any service, require no hoods for outdoor work, and are supplied with a fine ornamental fixture for interior use. This company has done its full share of supplying new and valuable features in the interest of the users of the electric current.



AN EFFICIENT INSULATOR.

An Efficient Insulator.

The Hemingray Glass company of Covington, Ky., has placed upon the market an insulator, a cut of which is presented herewith, and which possesses many points for consideration. It is made of glass, and is provided with a series of teeth at the lower edge of the insulator shield to attract and gather at their points drops of water running down the outer surface. The advantages of such a construction are evident, and the company is making preparations to push the sale of this specialty in all portions of the country. The device is fully protected by patents.

CORRESPONDENCE.

New England News.

BOSTON, February 21.—A joint legislative committee visited New York last week to inspect the Boynton bicycle railway in order to report upon the advisibility of granting that company a charter to operate in Boston and vicinity. This year's Legislature has its hands full of street railway matters. The following petitions are to be acted upon: The Lowell & Suburban Street Railway company, for amending its charter; the Lynn & Boston Street Railway company, for authority to lease the property of the Boston & Revere Electric Street Railway company; the Holyoke Street Railway company, for authority to extend its tracks over private lands; the Malden, Melrose & Stoneham Street Railway company, for an amendment of charter; George F. Butterfield and others, for same purpose; the Braintree Street Railway company, for authority to purchase property of the Randolph Street Railway company; the Bridgewater & East Bridgewater Street Railway company, for authority to sell or lease property to the Brockton Street Railway company; the Haverhill & Georgetown Street Railway company, for amendment of charrer; the Brockton & Bridgewater Street Railway company, for authority to sell or lease its property to the Brockton Street Railway company; Hamilton Perkins and others ask for an act of incorporation for a street railway between Haverhill, Mass., and Nashua and Manchester, N. H.; the Brockton & Holbrook Street Railway company, for authority to sell or lease its property to the Brockton Street Railway company; the Braintree Street Railway company, for authority to extend its lines; the Brockton & East Bridgewater Street Railway company, for authority to sell or lease its property to the Brockton Street Railway company; the Randolph Street Railway company, for authority to sell its property to the Braintree Street Railway company; the Whitman Street Railway company, for authority to sell or lease its property to the Brockton Street Railway company; the Wakefield & Stoneham Street Railway company, for authority to buy other street railways; the Brockton & Whitman Street Railway company, for authority to sell or lease its property to the Brockton Street Railway company; the Lowell & Reading Street Railway company, for amendment of charter; the Boston & Revere Electric Street Railway company, for authority to lease its lines; the East Side Street Railway company for authority to sell or lease its property to the Brockton Street Railway company; the Brockton Street Railway company, for authority to purchase the Brockton & Holbrook Street Railway company. In addition to these the Legislature is called upon to act upon charters asked for the Boynton Bicycle Railway company, the Meigs elevated scheme, and to amend or repeal the subway act for Boston.

The Boston subway commissioners are considering taking the abandoned Boston & Maine railroad Haymarket square station for one terminus for the subway.

The New England Telegraph & Telephone company is making rapid progress in Newton, in putting its wires underground. The conduits of Pearl and Center streets will be about a mile and a half long, and contain 175 wires.

The General Electric company started up its factories in Lynn last week on full time. The company has recently received several large orders, which render this move possible. About 1,500 hands will be given employment on a 56 hour schedule.

The project of connecting Haverhill, Mass., and Nashua and Manchester, N. H., by an electric railway has taken shape enough to warrant the introduction into the Massachusetts Legislature of a bill for a charter. This movement has been under way for some time, but first took on a tangible form last October, when about seventy representatives of New Hampshire towns met in the rooms of the Haverhill Board of Trade and discussed the feasibility of the idea. The scheme includes over sixty miles of road. Two weeks after this preliminary meeting the Manchester Board of Trade took up the matter. The officers of the Haverhill board were present and advocated the plan. An elaborate map of the section of country interested was prepared and published. This showed a trunk line of double tracks from Nashua through Hudson to Salem depot and Salem, N. H., thence to Ayers Village and Haverhill. The distance is about twenty miles from Nashua to Haverhill, both of which places are on the Merrimack River. The line proposed is a fairly straight one moving due east. A power house at Salem depot is contemplated. From this double track trunk line branches will extend to points north, southeast and west, to Lowell and Lawrence, Manchester, Chester and Derry. At Haverhill connection will be made with electric roads running to all points on the coast, Salem, Beverly, Gloucester, Rockport, Plum Island, Newburyport, Salisbury and Hampton, and with steamers on the Merrimack to Cape Ann and the Isle of Shoals.

Electricity is being used extensively in Boston theatrical advertising this winter. The Columbia Theater first constructed an electric bill board 84 feet long, which was brilliantly lighted at night by a row of 90 incandescent lights across the top. Now the Boston Theater has put up a big electric sign. This is a vertical rectangular column carrying block letters on its two broad sides. It is placed about five feet from the front of the theater and revolves on its vertical axis every minute. The body of the sign is a light lattice column constructed so strongly that

it will withstand a wind pressure of 50 miles an hour. The Edison three-wire system is used. The letters are 16 by 24 inches, and each carries 12 16 candle power incandescent lamps.

The West End Street Railway company has recently put in the largest freight elevator in the city in its Bartlett street house. It will be used for raising the heaviest cars. It is operated by a 25 horse power Thomson-Houston motor. It will raise a loaded four horse truck with ease.

J. C. E.

PERSONAL.

Albert Scheible, well known in electrical circles through his connection with George Cutter, Chicago, has just returned from a southern trip.

Charles Selden, telegraph superintendent of the Baltimore & Ohio railroad company, was in Chicago last week, the guest of C. F. Annett, assistant telegraph superintendent of the Illinois Central Railroad company.

The friends of Myron A. Knapp of Chicago will learn with sincere regret of the death of his mother, Mrs. Katherine Knapp, at Racine, Wis., on February 22d. Mrs. Knapp was 63 years of age, had resided in Racine for nearly 45 years and had surrounded herself with a number of friends who will deeply feel their loss. The death of Mrs. Knapp, although sudden, was not unexpected. The burial took place at Racine on February 24th.

ELECTRIC LIGHTING.

An electric lighting plant will be established at Griffin, Ga.

A municipal electric lighting plant may be erected at Gallatin, Tenn.

Ottawa, Ont. has applied to the Legislature for authority to buy an electric lighting plant.

Grand Rapids, Mich. is again agitating the question of owning a municipal electric lighting plant.

The plant of the Denver, Colo., Consolidated Electric Light company was damaged to the extent of $5,000 by fire on February 6th.

The Prairie du Chien, Wis., Electric Light company is putting in a new plant at that place. Work on the building has been commenced.

It is more than probable that Plano, Tex., will soon be supplied with incandescent lights, and it is said that the machinery will soon be placed.

An electric light company has been formed at Assumption, Ill., and will immediately put in a system. The lights will be of fifty candle power each.

It is stated that the importation of American petroleum at Bilbao fell from 7,000 tons in 1888 to 3,278 tons in 1892, a diminution due to the extension of electric lighting in the northern part of Spain, where waterfalls abound.

The proposition of the Cincinnati Gas Light & Coke company to absorb the capital stock of the Cincinnati Electric Light company was adopted at a special meeting of the shareholders in the gas company without any appreciable dissent.

The contract between the city of Hamilton, Ont., and the Hamilton Electric Light & Power company will terminate on the first of September next. The city authorities are talking of purchasing the necessary plant to do their own lighting.

The corporation of Gaithersburg, Md., proposes to arrange a better system for lighting the town, and the question of a dynamo being put in to furnish light for both Gaithersburg and Washington Grove is again being agitated with good prospects of success.

The United States government is installing an electric lighting plant in the arsenal at Rock Island. An alternating current dynamo, having a capacity of 500 16 candle power incandescent lamps, has been purchased from the General Electric company. Water power will be used.

Sealed proposals for furnishing for a term of five years any number of arc electric lights for the streets and parks of Boston, as requested or legally authorized, were opened in the office of the superintendent of lamps recently. The Boston Electric Light company was the only bidder.

The people of Annapolis, Md., complain that they are obliged to pay too much for the gas and electric illumination furnished them by the Annapolis Gas Light company. So much discontent has been shown, it is said, that the authorities are seriously considering the advisability of installing a plant to be operated by the municipality.

Leadville, Colo., is to have a new electric light company. The Citizen's Electric Light company has been organized by Leadville people who have asked the city council to grant them a 20-year franchise. The council has appointed a special committee to examine into the matter and to call a special meeting relative to the matter.

A large meeting of aldermen and councilmen was held in Buffalo, N. Y., February 8th, to consider the question of establishing an electric light plant to be owned and operated by the city. The meeting voted in favor of placing $100,000 in the estimate this year for the purpose of establishing an experimental electric lighting station. Territory in Black Rock or East Buffalo will be selected and reserved for the experiment.

The London, Brighton & South Coast Railway company of England, has thirty of its trains lighted by electricity, and is now about to equip a number of additional trains. The company claims that about fifteen per cent. more work can be secured from an electrically lighted than from a gas lighted train, which makes a saving in first cost of about $225,000, as eighty-five electrically lighted trains can do the work of 100 gas lighted trains.

ELECTRIC RAILWAYS.

A charter is to be applied for the construction of a bicycle electric railway from Winnipeg to Louisburg, N. S.

A resolution has been passed by the Boston common council to request all corporations operating cars in the city to prohibit the use by passengers of the front platform, and to provide gates on each side of the same, as is now done on one side, and to further provide a suitable fastening on the outside of the doors, so as to render it impossible for a passenger to use the platform in any manner.

The Mount Mansfield Electric Railroad company has been incorporated. The company is organized to build and operate a standard gauge electric railway between Waterbury and Stowe, Vt., a distance of 10 miles. Ample water power is available. The road is to be equipped for the transportation of both freight and passengers. Stowe has voted to give $40,000 toward its construction. The estimated cost of the building and equipping of the road is $150,000.

A successful trial trip was made a few days ago over the Park & Island Railway company's line at Montreal, Que. The tracks are laid on a solid stone foundation, T rails being employed. The St. Jean Baptiste Electric company furnished the power for the operation of the road. Cars considerably larger in size than the ordinary city electric street cars are to be used. It is expected that at the end of the present year forty miles of track will have been constructed.

There is likely to be a rate war among the electric companies of Baltimore, Md. The City & Suburban company, when its line was operated by horses, inaugurated the custom of selling six tickets for twenty-five cents. This was done in order to compete with the existing electric railway companies. Now that the City & Suburban company's lines are operated by electricity the other companies think this custom should be abolished. If it is not, they intend to sell eight tickets for the same price.

The electric cars on the new Thirteenth street and Fifteenth street lines of the Philadelphia Traction company stop at the near crossings of intersecting streets instead of at the farther. It is said that the plan meets with general approval, although the change from the previous custom created some confusion and annoyance. The company has come to the conclusion, after investigating the matter carefully, that the danger of accidents is very materially reduced when the stop is made at the near crossing.

The Toronto, Ont., Railway company has made a proposition to the city authorities regarding the hauling of city garbage by electric motors. The company agrees to furnish a motor car or electric locomotive, a motorman and a trolleyman for each train from point of loading to point of unloading for $1.50 per garbage car per round trip, a car not to contain more than ten tons. The matter has been referred to the city engineer. The agreement is to be for ten years with the option of renewal.

An electric train on the St. Louis & Suburban road and an electric train on the Washington Avenue & Lindell line collided on February 16th at the corner of Grand avenue and Morgan streets, where the lines cross each other. The cars were badly demolished and a number of passengers injured, two of them being dangerously hurt. One of the cars contained forty passengers and the other twenty-five. The Suburban car was completely turned over. The accident was due entirely to the carelessness of the motormen, as the cars were in sight of each other for nearly a block.

The Thomson-Houston International Electric company has recently completed the equipment of the third electric tramway on the overhead trolley wire system in France. The line is three miles long, and follows the bank of the Gironde from Bordeaux-Bouscat to Vigean, the gradients and curves being easy throughout. The line is provided with motor cars carrying forty passengers and weighing five tons and trail cars for fifty passengers. Each motor car is provided with a single reduction 15 horse power Thomson-Houston motor, weighing, with gearing, nearly one ton. The ordinary speed is 7½ miles an hour.

Along with the announcement that electric railways, between New York and Chicago and between New York and Philadelphia "are being projected," comes the statement that "the Canadian Pacific Railroad company will adopt the trolley system for moving trains over two sections of the Rocky Mountains. The power will be developed from the waters that rush down the precipices and tumble over the mountain sides. If such an experiment shall prove successful, the waters that flow over the surface of the Rocky Mountains will become of as great a value as the mineral wealth that is hidden in their interior." The Canadian Pacific Railroad company has it within its power to make some interesting experiments.

A project for connecting Highland Falls and West Point, N. Y., by trolley cars is said to be well under way. An electric company, with Capt. Charles F. Roe, Louis F. Goodsell, and G. F. Anthony, a Newburg lawyer, as the leading members, has been formed. The company has established a line of wires from a point south of Fort Montgomery through the town of Highland Falls to the railroad station, and will begin at once to furnish the town with electric light. If the authorities at West Point desire it, the company will furnish the military academy with light also. The plant is situated on Popolopem Creek, near "Hell Hole," where one of the bloodiest fights of the Revolutionary War occurred. The power will be furnished from water stored in ponds, which has its rise in the mountains.

As regards electric traction, says the London *Railway World*, we remain nearly at the point reached a year ago, although from undertakings which had then recently been initiated, encouraging experience has been derived. In March last the Liverpool Overhead Electric railway was opened; it has since been working with great success, and extensions of the line are probable. The South Staffordshire electric tramway has now been working for a year, and while no figures have yet been published as to the cost of electric traction, it is understood that they have been in a measure satisfactory. The public, at least, since a few irregularities incident to the introduction of new apparatus and methods have been remedied, has expressed nothing but approval of the change from horse traction. The lines have been visited by the officials of many other towns which are now contemplating the adoption of some form of mechanical traction. While but one or two of these projects have, however, passed the preliminary stages, there seems more reason than ever before to anticipate further developments in electric traction in the near future.

MISCELLANEOUS.

The electric lighting and street railway plant at Elkhart, Ind., was sold at auction to O. N. Lunbert, president of the old company, for $21,000 last week. The incumbrances are $75,000.

New machinery for the production of steel barrels is, says *Industries and Iron*, being put down at Barrow. The steel sheets which are used will be shaped by means of hydraulic presses when the metal is hot, and the half-barrels will be welded together by means of electricity.

The Akron Electrical Manufacturing company, Akron, O., has been placed in the hands of the president, Frank A. Wilcox, as receiver. The company is reported as perfectly solvent, and the present difficulty is brought about by its inability to collect debts which are now due. The affairs of the concern will be carried on as usual.

The Ohio House has passed the Harshbarger resolution providing for a special committee to ascertain the condition of the canals so far as needed improvements are concerned and the probable cost of equipping the waterways with electricity. If the report of the committee is favorable it is the intention to try the experiment of canal boats propelled by electricity on Ohio canals.

An ingenious lamp holder has been devised for the use of the musicians in an orchestra during a dark change in a theatrical or operatic performance. At the top of each music desk is a cylinder containing two sixteen candle power incandescent lamps. The cylinder has a quarter inch slit along its entire length, and when placed at a certain angle sheds light all over the page of music, while all around it is dark. This is far more effective in every way than the ordinary shade.

Some trials have just been made at Kiel on board the German war vessel Worth with an electrically lighted life-buoy, the invention of Capt. Melter. The buoy was thrown overboard when the vessel was proceeding at a speed of about 16 knots. For a space of about twelve seconds it was lost in the eddy currents caused by the twin screws of the vessel, but then reappeared. The new lifebuoy will be found useful at night time, and the experiments resulted so successfully that it is probable that it will be adopted generally in the German navy.

A suit has been brought by the corporation counsel against the Cincinnati Edison company and its bondsmen for $100,000, the full amount of the bond entered into with the city for the lighting of the districts in which the company has franchises. It is alleged that the company has violated its contract by failing to light the second district of the city at the time specified, and that the city, having been put to a great amount of inconvenience and expense therefrom, it is due to the corporation and its citizens that the bond which was given for that purposed be foreited.

The Thompson Electric Welding company of Lynn, Mass., has brought suit in the United States circuit court against the Two Rivers Manufacturing company and Mann Bros. of Milwaukee to recover damages alleged to have resulted from infringement of patents controlled by the Thompson company. The Thompson company alleges that patents granted to it in 1886 and 1888 covering an electrical welding machine, are encroached upon, whereby the defendants are deriving great gains and profits. The court is asked to issue an order restraining the Two Rivers company from further encroaching upon their rights and to turn over to them the profits and gains resulting from machines made after their patents.

TRADE NEWS.

Walter C. McKinlock, of the Metropolitan Electric company, Chicago, has just returned from a trip through Indiana and Ohio, where he secured a number of excellent orders for the Metropolitan company, W. H. McKinlock has also gone upon the road seeking the advancement of his company. He is now in the West closing contracts. The company recently received two large consignments of the P. & B. products as it is the intention to keep enough in stock to supply any demand promptly.

The Electric Appliance company, Chicago, reports that its fixture business has increased to a point where it finds it necessary to carry a large line of fixture accessories in stock in Chicago. It is prepared to furnish from Chicago a full line of electric glassware insulating joints, electrolier wire, fixture cut-outs, etc. The contract for furnishing

the electric lighting fixtures for the new addition to the Chicago post office has just been completed by the Electric Appliance company. The contract was secured only after considerable competition, and the Electric Appliance company feels considerably elated at having been able to secure the contract.

"The History of a Lead Pencil," published by the Joseph Dixon Crucible company, Jersey City, N. J., is as complete a history of the growth and modern use of that most useful of common articles, the lead pencil, that one could wish to possess. The pencil has become such a familiar article to the busy world that one seldom stops to think of the process by which the different grades and styles are turned out. This book, however, describes and illustrates all of the pencils manufactured by this company, which is equivalent to saying that it treats of lead pencils generally. The subject is not without interest, and the book is certainly an authority.

The National Telephone Manufacturing company, Boston, Mass., is calling attention in a circular letter to the fact that Prof. W. L. Puffer, of the Massachusetts Institute of Technology, in a lecture on telephone receivers delivered at the Wells Memorial Institute on February 13th, stated that as a result of his experiments comparing the different styles and makes of instruments, the particular receiver telephone of the National Telephone Manufacturing company, as shown, was the strongest and most powerful instrument. He especially remarked that the two Bell receiver telephones, as shown, were good instruments, but that the National must be rated as first. Many receiver telephones, both foreign and domestic, were exhibited. This decision, coming from such a competent authority, is regarded as gratifying by the National Telephone Manufacturing company.

The Page Belting company has issued an interesting book designed to give an adequate idea of how generally the company's product was used at the World's Fair. This it accomplishes in a very satisfactory manner by means of a number of excellent halftones made from pictures taken of machinery upon which were used the belts of this company. Exposures of 10 and 12 minutes were made upon machinery in motion, and so accurate was the running of the belts that the pictures show no blur. Prominent among the illustrations is the reproduction of the St. Gaudens medal, which was first shown to the trade by the Page Belting company, and of which the company received two from the Columbian Exposition. The book is tastefully compiled, and in itself gives a very satisfactory idea of some of the mechanical features of the fair. The Chicago office of the company is located at 165 Lake street.

The W. D. Graves Electrical & Machine Works, Cleveland, O., has addressed an illustrated book to its friends and patrons, which shows most of the specialties handled by this concern. Prominent among these is the Graves arc lamp, which will burn either singly on incandescent circuits or will run two or more in series, according to voltage, and consume any desired quantity of current to make a light of very high efficiency. The lamp is made for all direct circuits, either arc or incandescent. No dashpots, clockwork or complicated set of springs are used in connection with this lamp. A street hood has also been placed upon the market by this company in connection with the lamp. When for use on the incandescent circuit an adjustable rheostat is placed inside of the hood, together with fuse, making it only necessary to run wires from the mains direct to the lamp. When for direct arc circuits, the hood is supplied with a cut-off, so that the lamp can be taken out and another put in its place while in circuit without causing interruption to other lights. Another article made by this company is the Graves transformer, which possesses all the requirements for a successful specialty. In the book are also to be found illustrations of the switches and hanging boards, which form part of the trade of this company.

BUSINESS.

The Indiana Rubber & Insulated Wire company, Marion, Ind., will be represented at the convention by Frank W. Brigham.

The Bryant Electric company, Bridgeport, Conn , whose western office is in the Monadnock building, Chicago, is putting an excellent 500 volt cut-out on the market.

The Okonite company, New York, will be well represented at the convention by those convincing expounders of the virtues of Okonite, Captain Willard L. Candee and George T. Manson.

Kohler Brothers, Monadnock building, Chicago, western agents of the Eddy Electric Manufacturing company, feel very well satisfied with the amount of business they have done during the last two months.

C. M. Turnquist, Lakeside building, Chicago, reports having been very busy of late shipping small express and mail orders to all parts of the country for house goods, such as annunciators, burglar alarms, small motors, bells, batteries, home medical battery outfits, etc.

The attention of electrical engineers is directed to the Samson turbine water wheel, built by James Leffel & Co., Springfield, O. This wheel is furnished in a number of styles on upright and horizontal shafts, and is specially designed and adapted for driving electric lighting and power plants.

The Metropolitan Electric company, Chicago, is introducing a three-way switch made by H. T. Paiste. This switch has a great many advantages. It has a long arc and the make-and-break is absolute. The company is receiving numerous testimonials regarding the N. I. R. wire. An important user writes that his electrical engineer considers N. I. R. the finest wire he has used, and that he has used all kinds.

The Electric Appliance company, Chicago, finds great pleasure in being able to report that it is again prepared to furnish the old Packard lamp made as it used to be made in the first days of the lamp business. This announcement will be welcomed by electric light men who appreciate the economy of using a high grade article at a slightly advanced cost. Before the months of patent litigation the Packard lamp was very popular. It has been squelched for some time, but is again on decks and at will once take its place at the head.

The Abendroth & Root Manufacturing company, 28 Cliff street, New York, reports a brisk demand for its Root improved water tube steam boiler, with recent orders of 248 horse-power from the Para, Brazil, Electric Light company; 2,000 horse power for the tunnel plant, from the Baltimore & Ohio Railroad company, Baltimore, Md.; 4,000 horse power from the Cincinnati Street Railway company, and two large boilers from the Flatbush Gas company, Flatbush, Long Island, N. Y. The Root boiler is well known to the electrical fraternity.

The Ball Engine company, Erie, Pa., has made a number of installations in connection with various types of dynamos. Among late ones may be mentioned two 200 horse power Cross compound engines, directly connected to Siemens & Halske dynamos in the Lumber Exchange building, Minneapolis, Minn.; one 125 horse power simple engine, in connection with a Waddell-Entz dynamo, in the store building of Willoughby, Hill & Co., Chicago; one 80 horse power engine, in connection with a Waddell-Entz dynamo, in the building of Cumner, Craig & Co., Boston, Mass.

W. D. Holmes and George W. Walker, manufacturers' agents, 136 Liberty street, New York, are placing on the market a new and novel electric shade, which has several advantages combining lightness, durability and low price. The shade is made of celluloid, and has a fixture attached, which will be suitable for any socket. These shades are in all colors, from a dark bottle green to a plain white, are unbreakable, and can be washed the same as porcelain. They have also a cheaper grade made of paper, which is having a large sale among the central station and factory plants. Mr. Holmes and Mr. Walker are well known to the electrical fraternity, and are to be congratulated upon securing such a good agency.

The metal sheathed bushing which the Central Electric company has recently put on the market, conforming with the underwriters' requirements, has come into immediate popularity, and in explanation of the reason the Central Electric company says that there is no better article of a similar nature offered to the trade. It is confidently expected that this bushing will take the place of glass, porcelain and vulcanized rubber, as the expense is considerably less, and it is better adapted for the use it is intended, being easily and safely driven in position without liability of breaking. The Central Electric company has a complete stock of the various sizes, and is prepared to fill orders promptly. The demand for Manson tape is steadily on the increase; in fact it has been so large that the Central Electric company has found it difficult to keep a sufficient quantity in stock. This tape is of the Okonite company's manufacture.

H. F J. Porter, who was the first assistant mechanical engineer at the late exposition during its period of construction, and afterwards assistant chief of the machinery department, has formed a partnership with Albert Fisher, formerly Chicago representative of the Ball, Watertown and Green Engine companies, and together they have opened an office at 1025 Monadnock block, where, under the name of Fisher & Porter, they will carry on a contracting engineering business in the line of complete equipment of steam plants, giving especial attention to large work. They have been made western representatives of the Providence Steam Engine company, sole builders of the improved Greene engine, and of the Altoona Manufacturing Company, builder of the M. A. Green engine, thus handling engines of the very highest grade of both the slow and high speed types. The firm is prepared to meet any demand for first-class work in this direction. It is making arrangements with other eastern manufacturers as agents, and expects to be ready in other lines to take advantage of the incoming tide of business, of which it already sees indications.

ELECTRICAL PATENTS.

Issued February 20, 1894.

514,902. Alternating Current Motor. C. S. Bradley, Avon, N. Y.

The motor is provided with a primary element and two closed secondary circuits on the other element, one of high and the other of low resistance, means being provided for shifting the elements relatively, so that the primary may co-operate with either or both secondaries.

514,903. Alternating Current Motor. C. S. Bradley, Avon, N. Y.

The motor has one element wound to develop progressively shifting magnetic poles, and the other element provided with a closed secondary circuit inductively related to the shifting poles, means being provided for developing opposing electromotive forces in the secondary circuit, a common branch path of relatively high resistance being provided for currents due to the opposed electromotive forces.

514,904. Alternating Current Motor. C. S. Bradley, Avon, N. Y.

The motor is provided with two armature circuits, one of which is an inductive circuit continually closed upon itself, and the other of which is connected with the source of supply through a re-directing commutator, which produces constant polarization of the armature core at synchronous speed, whereby the latter will fall into operation when the motor approaches synchronism.

514,907. Dynamo-electric Machine. C. F. Brush, Cleveland, O.

The dynamo is provided with two series of field magnets, two or more coils of conductor having their planes substantially in the line of their movement between the poles of the field magnets, a diamagnetic support on which the coils are mounted, and a shaft composed of sections separated by insulating material.

514,913. Cushion for Telephone Receivers. V. A. Cook, Averill Park, N. Y.

An elastic annular cushion is attached to the end of the receiver, which is held against the ear, thus excluding extraneous sounds while listening at the receiver, as well as furnishing a soft bearing against the ear.

514,916. Telephone. D. Drawbaugh, Eberlys Mill, Pa.

A diaphragm carries two resistance-varying electrodes electrically insulated from each other, the opposing electrodes of each set being mounted upon vibratory supports and provided with means for adjusting the initial pressure between the electrodes.

514,920. Telephone Transmitter. P. Fitzsimons, Birmingham, Ala.

514,925. Electric Cable. Theodore Guilleaume, Muelheim-on-the-Rhine, Germany.

514,932. Trolley Wire Support. R. M. Hunter, Philadelphia, Pa.

514,933. Transformer. F. S. Hunting, Fort Wayne, Ind.

The transformer is adapted to develop from two or more magnetic cores or circuits, in which the magneto-motive forces differ in phase, an induced current of definite phase displacement, and comprises a series of coils inclosing respectively the magnetic circuits, the number of convolutions in the several coils being apportioned to develop a resulting current of the desired phase.

514,960. Electric Bell Alarm. William H. Orpen, Jr., Brooklyn, N. Y.

514,972. Electric Railway System. N. Tesla, New York, N. Y.

The system comprises an insulated and electrically screened supply conductor extending along the line of travel, and a motor car carrying a conducting plate or bar in inductive relation to the screened conductor and in electrical connection with the motor, the screened conductor carrying currents of high potential and frequency.

514,973 Electrical Meter. N. Tesla, New York, N. Y.

The method of measuring the amount of electrical energy expended in a given time in an electric circuit of alternating currents consists in maintaining by such currents a high tension discharge through a rarefied gas between two conductors, and computing from the amount of the particles thrown off from the conductors, or one of them, by the action of the discharge, the energy expended.

514,975. Electrical Annunciator. N. M. Watson, Detroit, Mich.

514,979. Battery. D. H. Wilson, Chicago, Ill.

514,980. Switchboard System. D. H. Wilson, Chicago, Ill.

514,981. Circuit Making and Breaking Device. D. H. Wilson, Chicago, Ill.

515,020. Electrical Converter. A. L. Riker, New York, N. Y.

515,022. Electric Arc Lamp. L. W. Rushmore, Brooklyn, N. Y.

515,087. Electric Distribution Box. O. D. and M. A. Kleinsteuber, Milwaukee, Wis.

515,108. Electrical Circuit Controller. R. Callender, Brantford, Can.

515,109. Electrical Circuit Controller. R. Callender, Brantford, Can.

515,110. Automatic Signaling Transmitter. R. Callender, Brantford, Can.

515,125. Arc Lamps. W. O. Meissner, Chicago, Ill.

515,145. Electric Signaling Between Railway Trains. J. J. Czepull, Lancaster, Pa.

515,179. Electric Railway Conduit. M. S. Towson, Cleveland, O.

515,192. Material for Insulating Electric Wires. Gustave A. Caunot, London, Eng.

The insulating material comprises a coating of albumen, peat fiber, spermaceti and tar.

515,205. Electric Arc Lamp. Bruce Ford, Johnstown, Pa.

515,216. Dynamo or Electric Motor. L. Gutman, Pittsburg, Pa.

515,238. Trolley Conductor and Support. M. D. Law, Washington, D. C.

515,241. Rheostat. J. B. Lyon, Brooklyn, N. Y.

515,254. Rheostat. A. J. Shaw, Muskegon, Mich.

515,255. Electric Elevator Brake. A. J. Shaw, Muskegon, Mich.

515,256. Electric Elevator Brake. A. J. Shaw, Muskegon, Mich.

515,274. Indicator for Electric Cars. Henry C. Beckman, St. Louis, Mo.

515,280. Rheostat. G. A. Brown, Muskegon, Mich.

515,281. Electric Elevator Brake. G. A. Brown, Muskegon, Mich.

515,286. Electric Steering Gear. Frank L. Dyer, Washington, D. C.

515,304. Rheostat. A. J. Shaw, Muskegon, Mich.

515,308. Electric Railway Trolley. C. J. Van Depoele, Lynn, Mass.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, MARCH 10, 1894. No. 10

M. J. Francisco, President National Electric Light Association.

It is appropriate at this time that the National Electric Light association should select for its chief executive officer the man who more than any other member has been the champion of the central station companies against the encroachment of municipal officers and parent companies. M. J. Francisco, who was elected president for the ensuing year at the Washington convention last week, has long been identified with the association work, and has contributed largely to the growth and influence of the organization.

Mr. Francisco is a Vermonter by birth, and lineally descended from the men who made the Vermont shore of Lake Champlain famous during the days of the Revolution. He entered Oberlin College at an early age, and, after completing his studies, traveled extensively in the South and West, locating in Harrisburg, Pa., in 1867, where he established the Pennsylvania College of Trade and Finance. Over this he presided until failing health compelled him to return to Vermont, since which time he has been identified with the best interests of his native state. As manager of many of the largest English insurance companies, he has made an excellent record in New England. He entered the electric light field in 1887 as the president of the Rutland Electric Light company, becoming a member of the National Electric Light association in its early struggles He was made a member of the executive committee at the Kansas City convention and second vice-president at Providence. He was advanced to the position of first vice-president at the St. Louis convention, and at the Washington meeting last week was elected president. At the Cape May convention he read his first paper on "Municipal Ownership," which attracted wide-spread attention. He has contributed to many scientific journals on this and kindred subjects. In 1893 he published a book entitled "Municipal Ownership—Its Fallacy," which secured favorable mention from the press of this country and Europe.

Mr. Francisco's reputation, both in electric light and insurance matters, has been such that he has been called to Washington, and before the state Legislatures of Massachusetts and Vermont to discuss matters pertaining to these subjects. In 1863 he married the daughter of Israel Holmes, the founder of Holmes, Booth & Hayden, a name familiar to all electrical men.

M. J. FRANCISCO.

The Washington Convention.

Last week's meeting of the National Electric Light association at Washington was important to all who have the interest of the association at heart. For the first time the association broke away from the tradition of holding the convention at the home of the president. Then, too, the social features were not permitted to monopolize the attention of the members; in fact, there was an organized effort to make them subordinate to the business of the convention, and in this the association was successful. As a result, the meetings were well attended, the discussions were pretty generally participated in, and altogether the convention had more of the air of a business gathering than any of those that have been held of late years.

A feature of the meetings was the presence of many men who formerly figured prominently in the work of the association, but who have not given the organization as much personal attention and have not taken an active part in recent conventions. On Wednesday morning several of these gentlemen occupied seats on the platform and after the meeting they took occasion to renew old acquaintances among the members. Among the former presidents of the association who attended the meetings were J. Frank Morrison of Baltimore, Edwin R. Weeks of Kansas City, Marsden J. Perry of Providence, Charles R. Huntley of Buffalo and James I. Ayer of St. Louis. The reappearance of Messrs. Morrison and Perry showed that these gentlemen had not lost interest in the association. Mr. Weeks has been a familiar figure at conventions for years, rarely missing a meeting. Messrs. Huntley and Ayer were warmly welcomed, as recollections of the hospitable treatment accorded the members at Buffalo and St. Louis were still fresh in the minds of the delegates.

A feature of the convention was the discussion of several important topics upon which the speakers selected were recognized authorities. This discussion generally developed into one in which the entire convention took part, and in this way the interest was maintained. Another new feature introduced at this convention was the question box. Members were requested to ask any and all questions that pertained to the association. Executive sessions were held each day, at which subjects of management, policy and other topics of special interest to members were discussed. These meetings were well attended and proved an attractive feature.

On Tuesday the ladies in attendance were given a carriage ride about town, the public buildings, grounds, boulevards and residence districts being visited.

One of the most interesting numbers on the programme was the lecture by Messrs. Martin and Stieringer on the World's Fair lighting effects. There were many fine views shown, illustrating the principal features of the lecture.

Each member of the association was presented a handsome souvenir of the meeting in the form of a sterling silver sword for a scarf pin.

American Institute of Electrical Engineers.

At the February meeting of the American Institute of Electrical Engineers the following named gentlemen were elected associate members: Clifford D. Babcock, New York, N. Y.; William S. Barstow, Brooklyn, N. Y.; Albert L. Clough, Manchester, N. H.; James W. Crosby, New York, N. Y.; George Forbes, London, England; Arthur Frantzen, Chicago, Ill.; Edward M. Gerry, Newark, N. J.; Charles Gesseaume, Newark, N. J.; Harold Harrison, Montclair, N. J.; E. Randolph Hix, New York, N. Y.; James A. Lighthite, San Francisco, Cal.; H. H. Morehouse, Guatemala, Central America; Charles E. Potts, Brooklyn, N. Y.; Albert E. Richardson, London, England; Charles F. Rittenhouse, New York, N. Y.; S. D. Snook, Brooklyn, N. Y.; E. W. Trafford, Richmond, Va.; Augustus Treadwell, Jr., Brooklyn, N Y.; George E. Wendle, South Bethlehem, Pa.

On the approval of the board of examiners the following named associate members were transferred to full membership: Byron C. Wolverton, Elmira, N.Y.; C. R. Van Trump, Wilmington, Del; William D. Sargent, Brooklyn, N. Y.; Clarence E. Gifford, Buffalo, N. Y.; Jesse R. Lovejoy, Boston, Mass.

The following circular letter has been issued by W. J. Hammer, chairman of a special committee of the American Institute of Electrical Engineers, appointed for the purpose of securing a reconsideration of a recent ruling of the Postoffice Department. This letter has been addressed to members of Congress and United States senators, and the Institute desires the co-operation of other societies in the work:

Under recent rulings of the Postoffice Department all papers published by colleges, fraternities, scientific or professional societies are now denied admission to the mails as second-class matter, and hence such journals are compelled to pay from eight to sixteen times as much postage as other papers. The American Institute of Electrical Engineers, the representative organization of the electrical profession in this country, believing that such a ruling is a manifest disadvantage to itself, as well as to similar scientific and professional societies, the distribution of whose publications confers very great benefits upon its members and upon the world at large, and believing it to be to the best interests of our country that the Senate and House of Representatives should assist and foster the efforts of all such scientific and professional organizations as our own in their efforts to disseminate knowledge, and being informed that a bill has been introduced in the Senate by Senator Manderson, said bill being Number 1,353, and a similar bill, Number 4,897, having been presented in the House by Hon. E. J. Hainer, which bill has been introduced with a view of making an exception in favor of benevolent and fraternal societies and incorporated institutions of learning, we, the undersigned, representing a special committee appointed by the council of the American Institute of Electrical Engineers, request that the above bill, known as the Manderson Hainer bill shall be so modified as to include the regular monthly, quarterly or yearly publications of scientific and other professional societies.

The American Institute of Electrical Engineers has been informed that the representative engineering societies of this country will take similar action in regard to this matter, and so important do we deem this that our committee has been requested personally to present our application in Washington. It seems strange that such publications as our own, until recently accorded the second-class (one cent per pound) rates, are now ruled out, while such publications as the *Police Gazette* and pirated cheap novels still enjoy this privilege. We have been informed of one society of high standing in this country, which would be compelled to cease publishing its proceedings should its present large expenses be further increased by placing it under the recent rulings of the Postoffice Department. This will also apply to other scientific and engineering societies, and will very considerably hamper the work of all such professional societies as our own.

An Illuminated Wagon.

In electrical advertising the storage battery has proven to be a very important factor, especially where it is desired to furnish light for portable signs. One of the best and most attractive applications of this sort may be seen upon the streets of Chicago at night, where an ordinary delivery wagon, which has been equipped with the necessary appliances for producing electric light, attracts considerable attention. The wagon belongs to the "Hub" clothing establishment, and, as seen in Fig. 1, presents an exceedingly trim and light appearance. Around the glass sides, wired upon six circuits, has been placed about 80 six candle power incandescent lamps, taking nine volts. These lights are thrown in and out of circuit by means of a small cylindrical switch in the body of the wagon geared to a 1-16 horse power motor, current to which is furnished by a storage battery. Five 175 ampere hour secondary cells of the American Battery company's type supply the current for the lamps Their arrangement as well as the switch and motor are shown in the interior view of the wagon, Fig. 2. The lighting effects, however, are not confined to the wagon itself by any means, for wires pass out upon the harness of the horses, which is studded here and there with groups of miniature lamps, presenting a very pleasing effect. The passage of this brilliant, changing, flashing carriage down the streets at night, liberally covered with advertising matter, presents a hint to enterprising advertisers who are continually upon the look out for something novel and striking and portends a fruitful field for the consideration of storage battery men.

FIG. 1. AN ILLUMINATED WAGON.

Members and Visitors.

Following is a list of the members and visitors in attendance at the Washington convention of the National Electric Light association:

Adams, H. C.....New York
Alberger, L. R.....New York
Alexander, P. H.....Baltimore, Md
Andrews, W. S.....Lancaster, Pa
Annear, W.....Philadelphia
Anthony, Prof. W. A., and wife.....Manchester, Conn
Appleton, J.....Philadelphia
Armstrong, E. A.....Camden, N. J
Ash, J. R.....Washington, D. C
Atkinson, E. P.....New York
Ayer, James I.....St. Louis, Mo
Babcock, E. L.....Cuyahoga Falls, O
Babcock, C. A.....Cuyahoga Falls, O
Baker, Jr., C. O., and wife.....Newark, N. J
Baldwin, O. H.....Pittsburg, Pa
Banfield, W. F.....Baltimore, Md
Barnard, G. A.....Salem, O
Barstow, W. S.....Brooklyn, N. Y
Bauer, A. H.....Chicago
Beach, R. H.....New York
Beal, M. A.....Rockford, Ill
Brander, Thomas W.....Richmond, Va
Belote, James L.....Norfolk, Va
Belyen, Sanford.....Philadelphia
Bennett, Jr., E. H.....Elizabeth, N. J
Beran, T.....New York
Bibber, C. E., and wife.....Boston, Mass
Biddle, J. G.....Philadelphia
Blaxter, G. H.....Pittsburg, Pa
Bolles, F. G.....Washington, D. C
Bosley, A. L.....Frederick, Md
Boudinot, George S.....Washington, D. C
Bowen, M. D., C. H.....Washington, D. C
Bracken, William.....New York
Brady, T. H.....New Britain, Conn
Bragg, C. A., and wife.....Philadelphia
Brigham, F. W.....Boston, Mass
Brock, William M.....Paterson, N. J
Brophy, Capt. William.....Boston, Mass
Brown, George W.....Portland, Me
Brown, G. T.....Nashville, Tenn
Bryant, W. C.....Bridgeport, Conn
Buchman, E.....Wheeling, W. Va
Buddy, S. P.....Philadelphia
Burkett, J.....Washington, D. C
Burleigh, J. J., and daughters.....Camden, N. J
Burns, C. F.....Rochester, N. Y
Cabot, J. A.....Cincinnati, O
Caldwell, Edward.....Chicago
Calkins, F. E.....Chicago
Calverley, W. D.....Houghton, Mich
Candee, W. L., wife and daughter.....New York
Carnes, W. W.....Memphis, Tenn
Carpenter, C. E.....Bridgeport, Conn
Carter, George G.....Chicago

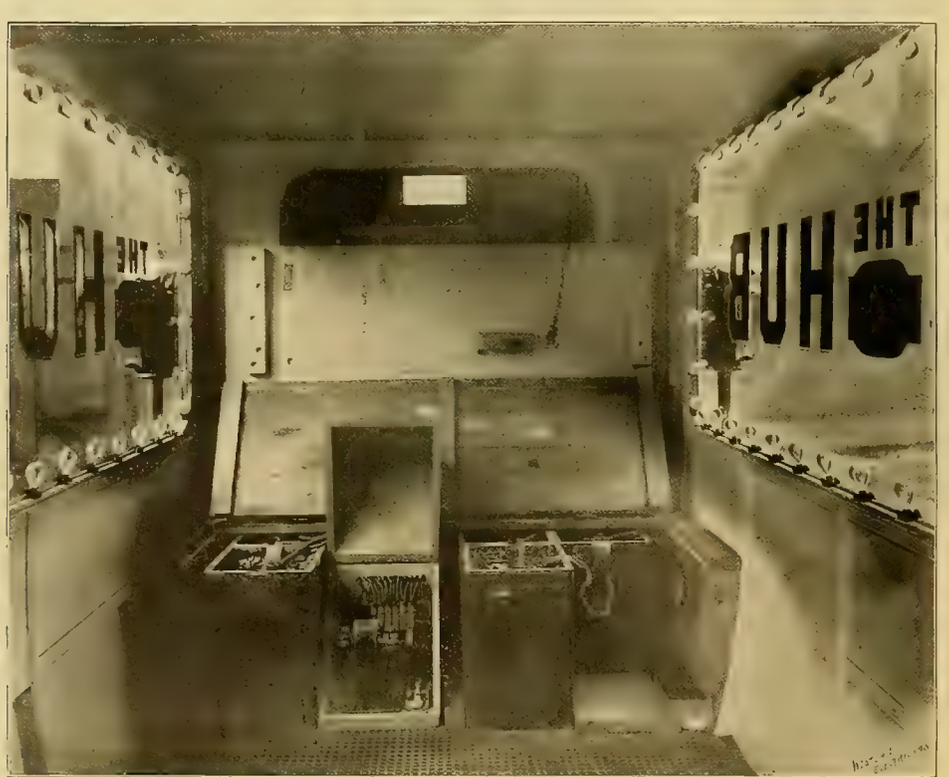


FIG 2. AN ILLUMINATED WAGON.

Cartwright, David J.....Boston, Mass
Cassier, Louis, and wife.....New York
Chamberlain, W. H.....Norfolk, Va
Chase, S. A.....New York
Childs, S. M.....Baltimore, Md
Christopher, C. F.....Washington, D. C
Cissel, R. B.....Newark, N. J
Clapp, A. W.....Washington, D. C
Clark, W. A., and daughters.....Wyoming, O
Clark, Frank H.....New York
Clay, Henry.....Philadelphia
Cleverly, H. A.....Philadelphia
Coffman, John R.....Northeast, Pa
Coles, S. L.....New York
Collins, W. Forman.....Chicago
Colvin, F. R.....New York
Comstock, L. K.....Chicago
Conney, J. W.....Baltimore, Md
Corey, R. B.....New York
Coughlin, W. H.....Wilkinsburg, Pa
Coulthurst, G. H.....New York
Cox, George E.....Baltimore, Md
Crane, W. F. D.....New York
Crane, F. N.....Newark, N. J
Crider, J. S.....Pittsburg, Pa
Crossman, T. E.....Brooklyn, N Y
Cummings, E. A.....Chicago
Cutter, H. B.....Philadelphia
Cuttriss, Charles.....New York
Darlington, F. W.....Philadelphia
Darrell, H. C.....Baltimore, Md
Davis, D. L.....Salem, O
Davis, Isaac.....Boston, Mass
Davis, Charles I.....Boston, Mass
Davis, H. M.....New York
Dee, James R.....Houghton, Mich
DeCamp, A. J., wife and daughter.....Philadelphia
DeLand, Fred.....Chicago
Dennison, G. G.....Washington, D. C
DeRonde, Frank.....New York
Doan, F. P.....Jacksonville, Ill
Dodge, Prof. O. G.....Washington, D. C
Doubleday, Charles D.....New York
Douglas, S. A., and wife.....New York
Downs, B. B.....Warren, O
Duncan, Dr. Louis.....Baltimore, Md
Dunlevy, H. H., and wife.....Wheeling, W. Va
Durborow, Jr., Hon. A. C.....Washington, D. C
Durling, C. R.....Baltimore, Md
Edgar, H. J.....Atlanta, Ga
Edwards, Charles C.....Baltimore, Md
Ellis, C. F.....Swissvale, Va
Ericson, C.....Baltimore, Md
Eshburn, C. T.....New York
Evans, D. E.....Baltimore, Md
Faber, Jr., C. R.....Toledo, O
Fairbanks, H. H.....Worcester, Mass
Fellows, W. H.....Springfield, Mo
Ferguson, J., and wife.....Brooklyn, N. Y
Ferris, W. J.....Chicago
Field, A. W.....Columbus, O
Field, John M.....Berlin, Conn
Field, C. J.....New York
Field, I. M.....Bridgeport, Conn
Findley, J. H.....Ogdensburg, N. Y
Fisher, G. H.....Philadelphia
Flavin, J. J.....Buffalo, N. Y
Foote, J. B.....Battle Creek, Mich
Foote, W. A.....Jackson, Mich
Foote, Allen R.....Washington, D. C
Forbes, George.....New York
Ford, Frank R.....Philadelphia
Foster, H. A., and wife.....New York
Francisco, M. J., and wife.....Rutland, Vt
Frye, Henry W.....New York
Fulton, George.....New York
Gage, N. W.....New York
Galloway, J. R.....Battle Creek, Mich
Gardiner, J. C.....Philadelphia
Gardner, J. G.....Toronto, Ont
Garnett, James.....Philadelphia
Gates, J. J.....Hartford, Conn
Gates, J. Holt.....Chicago
Gawthorp, E. B.....Baltimore, Md
Gorke, H. J.....Syracuse, N. Y
Graham, J. P.....Altoona, Pa
Gregory, C. E.....Chicago
Greeley, Gen. E. S.....New York
Greene, W. J.....Cedar Rapids, Ia
Greene, E. B.....Altoona, Pa
Greene, B. E.....New York
Greene, S. D.....New York
Groetzinger, A.....Pittsburg, Pa
Groff, W. E.....Harrisburg, Va
Gwynn, Joseph.....Steubenville, O
Haac, Felix.....Philadelphia
Hague, C. J.....New Haven, Conn
Hall, H. P.....Boston, Mass
Hall, J. P.....New York
Hall, Newton.....New York
Hamill, S. M.....Cleveland, O
Hammer, W. J., and wife.....New York
Hanks, W. F.....Philadelphia
Harrington, F. W.....New York
Harrington, W. E.....Camden, N. J
Harris, B. F.....Champaign, Ill
Harvey, A. W.....Chicago
Hatch, B.....Hartford, Conn
Hawkins, F. M.....Rochester, N. Y
Hayes, S. Q.....Washington, D. C
Heinrichs, R. O.....Newark, N. J
Heinrichs, Ernest H.....Pittsburg, Pa
Henkle, Chas. E.....Washington, D. C
Herrick, A. B.....Schenectady, N. Y
Hill, W. S.....Boston, Mass
Hills, C. I.....Hartford, Conn
Hinds, J. S.....Philadelphia
Hinds, J. L.....Syracuse, N. Y
Hoag, G. M.....Cleveland, O
Holden, A. L.....Boston, Mass
Holliday, E. M.....Wheeling, W. Va
Holmes, G. R.....Baltimore, Md
Holmes, R. P.....Youngstown, O

Hover, P. H.....Chicago
Howard, Louis .....New York
Howell, W. S.....Harrison, N. J
Hubbell, H. A.....Bridgeport, Conn
Hughes, C. C.....Baltimore, Md
Hunt, W. T.....New York
Hunter, Maurice.....Richmond, Va
Huntley, C. R.....Buffalo, N. Y

Insull, Samuel.....Chicago
Issertel, H. G., and wife.....New York

Jackson, George J.....Norwich, Conn
Jackson, G. T.....New York
James, A. B.....Baltimore, Md
Jennings, John J.....Wilkinsburg, Pa
Johnston, W. J., wife and daughter.....New York
Jones, A. J.....New Brunswick, N. J
Jones, C. E.....Cincinnati, O

Keck, T. P.....Savannah, Ga
Keefer, E. S.....New York
Kellogg, Jr., H. C.....Philadelphia
Kenfield, F. S.....Chicago
Kester, J. F.....Buffalo, N. Y
Key, W. S.....Boston, Mass
Kimball, A. H.....Fitchburg, Mass
Kimball, A. H.....New York
Kirkegaard, Georg.....Brooklyn, N. Y
Knox, F. H.....Baltimore, Md
Knudson, A. A.....New York

Merriam, E. B.....Cleveland, O
Mitchell, D. L.....Taunton, Mass
Mitchell, P. W.....New York
Moore, George T.....New York
Morrison, J. Frank.....Baltimore, Md
Morrison, W. J.....Syracuse, N. Y
Murphy, T. J.....New York

Nahm, Louis.....St. Louis, Mo
Neal, Frank D.....Washington, D. C
Newton, W. J.....New York
Newton, A. J.....Windsor, Conn
Newton, C. E.....Hartford, Conn
Nicholls, Fred.....Toronto, Ont
Noonan, J., and wife.....Paterson, N. J

O'Hara, J. B.....Chicago
Orford, J. M., and wife.....Boston, Mass
Osborne, W. F.....New York

Packard, W. D.....Warren, O
Page, A. D.....Harrison, N. J
Parsons, F. B.....New York
Patterson, A. H., and wife.....New York
Patterson, Hugh.....Baltimore, Md
Pease, Alfred H.....Hartford, Conn
Peck, E. F., and wife.....Brooklyn, N. Y
Pentz, J. A.....Philadelphia
Perkins, T. C.....Manchester, Conn
Perry, F. L.....Chicago
Perry, M. J.....Providence, R. I
Pfatischer, M.....Philadelphia

Schieren, Charles A., Jr.....New York
Scott, C. E.....Bristol, Pa
Scott, C. F.....Pittsburg, Pa
Searles, A. L.....New York
Seely, J. A., and wife.....New York
Sepp, Charles F.....New York
Sexton, H. W.....Anniston, Ala
Seymour, A. P.....Syracuse, N. Y
Seymour, E. W., and wife.....New York
Shain, C. D.....New York
Shainwald, R. L., and wife.....New York
Sharp, Jacob.....Salem, O
Shaw, Hon. G. B.....Eau Claire, Wis
Shaw, W.....Wilmington, Del
Shaw, A. C.....Boston, Mass
Shay, J. H.....Chicago
Shippey, H. L.....New York
Smith, J. E.....New York
Smith, H. J., and wife.....New York
Smith, R. B.....Philadelphia
Smith, T. Carpenter.....Philadelphia
Smith, J. O.....Baltimore, Md
Spenser, Thomas.....Philadelphia
Starr, C. C.....Halifax, N. S
Stetson, G. R.....New York
Stewart, Robert.....New York
Stieringer, L.....New York
Stillwell, L. B.....Pittsburg, Pa
Stirn, Louis.....New York
Stockwell, Edward.....Chicago
Stump, C. E.....New York

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Markle, A.....Hazleton, Pa
Marks, L. B.....New York
Marsh, F. W.....Pittsburg, Pa
Martin, C. C.....Parkersburg, W. Va
Martin, A. J.....Philadelphia
Martin, T. C.....New York
Martin, A. T.....New York
Mason, J. H., and daughter.....Boston, Mass
Maynard, George C.....Washington, D. C
McDuff, G. G.....New York
McGhie, J.....New York
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McIntire, J. D.....Washington, D. C
McLay, H. Kent.....Baltimore, Md
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Richter, Eugene.....Philadelphia
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Ridlon, Frank.....Boston, Mass
Ries, E. E.....Baltimore, Md
Robertson, A. M.....Minneapolis, Minn
Rodman, C. L.....Ravenna, O
Ross, E. L.....Indian Orchard, Mass
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Terry, F. S.....Chicago
Thelow, F. B.....Philadelphia
Thilow, F. B.....New York
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Thomas, Maurice W.....Richmond, Va
Thomson, D.....New York
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Weaver, W. D.....New York
Webster, N. D.....Philadelphia
Weeks, E. R.....Kansas City, Mo
Western, B. R.....New York
Weston, Edward.....Newark, N. J
Wetzler, Joseph.....New York
Wheeler, S. S., and wife.....New York
White, C. P.....Evansville, Ind

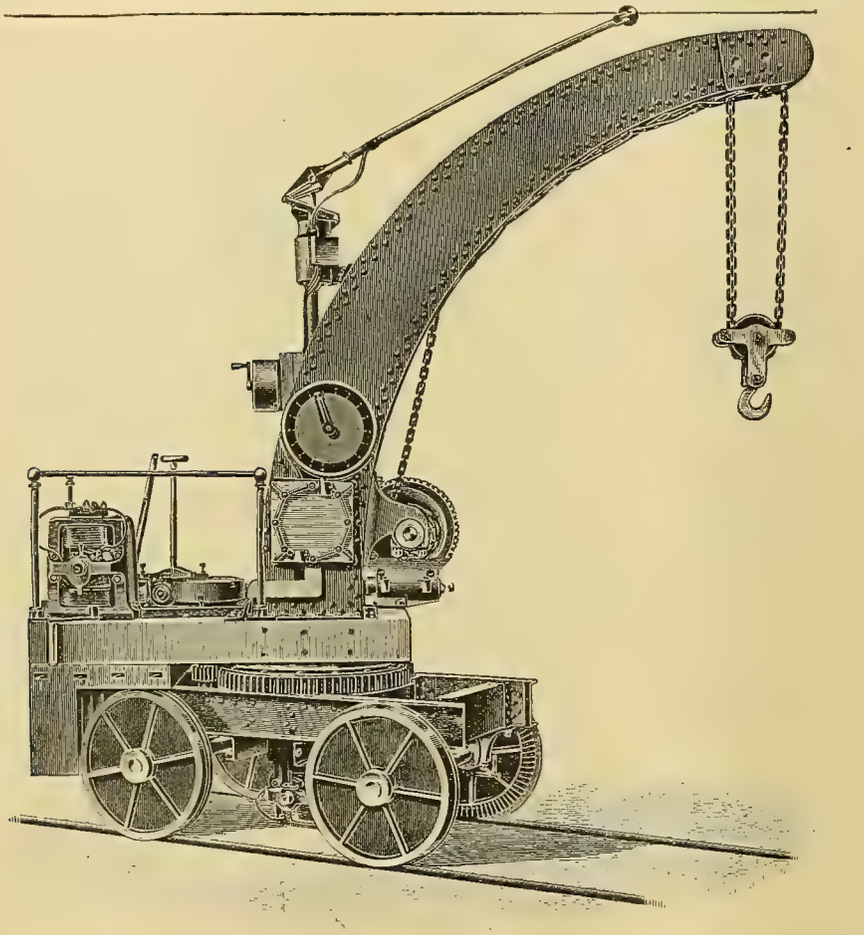
White, W. D. ..... Baltimore, Md
Wiley, G. L. ..... New York
Wilkins, F. H. ..... New York
Wilkins, E. Ward ..... Philadelphia
Wilkinson, E. T. ..... Philadelphia
Williams, J. R ..... Camden, N. J
Williams, F. H. ..... Buffalo, N. Y
Wilmerding, C. H. ..... Chicago
Wilson, C. H. ..... Chicago
Willyoung, E. G. ..... Philadelphia
Wood, E. E. ..... New York
Wood, M. M. ..... Chicago
Wood, W. B. ..... Philadelphia
Worswick, A. E. ..... Montgomery, Ala
Wright, Joseph, and wife ..... New York
Wright, Peter ..... Philadelphia
Wurts, A. J. ..... Pittsburg, Pa

Young, A. ..... Washington, D. C
Young, Alden M. ..... Waterbury, Conn
Young, C. P. ..... Baltimore, Md

Traveling Electric Crane.

The accompanying cut illustrates an electric traveling crane employed in the St. Chamond Steel Works, France. The crane is constructed on the principle of separate mechanism for the lifting and traveling motions, such as is adopted by the Maschinenfabrik Oerlikon for ordinary traveling cranes, and is for use on a horizontal track with turn-tables in an erecting shop. It has a total weight of 15 metric tons and will raise a load of 8 tons at the rate of 4 feet 5 inches per minute, and smaller loads at a proportionally increasing rate, the maximum being 7 feet 9 inches per minute. It will travel at the rate of 66 feet per minute, and slew at the rate of 18 feet per minute. The motors are of the standard types of the Maschinenfabrik Oerlikon. The motive power is conveyed to the lifting and traveling mechanism by means of a worm and worm-wheel. The motor for the lifting apparatus is on the platform, which turns with the jib of the crane. As the crane is carried on balls, the power required to turn it is exceedingly small, and it would not have been profitable to set up a motor for that purpose only, more especially as the space at disposal in the St. Chamond Steel Works was very limited. The motive power was therefore conveyed by inserting a small coupling, the connection being of course broken by uncoupling. The lifting chain is wound on a cast-iron cylinder, and to insure precision in the lowering of loads the axle of the worm turning the worm-wheel of the cylinder is provided with a brake. Moreover, it is possible to disconnect the working of this cylinder, so that both hoisting and turning movements are not only independent of each other, but may take place at the same time, the rapidity of each being controlled electrically.

The motor for locomotion is independent of the slewing motion, and drives one of the four wheels by means of worm and worm-wheel bevel gear. The traveling mechanism is in all respects similar to an electric locomotive. The transmission of the electrical energy is accomplished by the employment of an overhead conductor--a wire of hard copper of about 7 millimeters in diameter—which was stretched on special insulators above the center of the track, in the same manner as in an electric railway. This wire is above the highest point of the jib of the crane, so that the latter can move freely in every direction. A bronze trolley wheel at the end of the arm runs on the fixed conductor. Regard for the turn-tables at the crossings of the track and for the slewing of the crane jib (and the consequent turning of the platform with the man in charge and the electrical apparatus) made it necessary that the machinery for the transmission of the electrical energy should have two absolutely independent movements, namely: (1) A free movement of the contact arm around the vertical twining axle or the crane, and that without hindrance to its movement in a vertical direction; (2) a free movement of the arm and platform around the vertical axle of the crane. The slewing power of the traveling gear on the turn-tables is of equal importance with the turning power of the jib. Care must be taken that the current for the motor for locomotion, for the purpose of directing and controlling it upon the part which turns, and after it has passed the steering-gear, should be again conducted to the guiding fixed part of the crane. The starting resistances for both motors, as well as the switches controlling the current from them, are to be brought to the surface of the arm, thus being equally accessible to the man in charge, whatever the position of the crane. For guiding the motors and for uncoupling the brake five levers and a small hand-wheel are arranged near to each other. The general transmission of the current to the motors and regulators is provided for in a very simple manner by means of a small number of copper rings and contacts, which are all arranged in the box at the upper end of the pivot of the crane. No interruption of the current and no sparking can take place there. The consumption of current for lifting a load of 8 tons is 67 amperes, and for traveling the full load, 20 amperes. The crane is to work with three others of similar construction, and the machine for the generation of the current is an Oerlikon compound dynamo. The cut is reproduced from London *Industries and Iron.*



TRAVELING ELECTRIC CRANE.

The Importance of Complete Metallic Circuit For Electric Railways.[1]

By J. H. Vail.

In the early days of electric railway construction two distinctly different systems were devised and competed for public favor. The one being the overhead double trolley system, affording a complete metallic circuit for the outgoing and return of all the electric current required to move the motor cars, and the other being the single trolley system, using the track and earth as a common conductor for one side of the circuit, and the trolley wire and parallel mains for the opposite side. The double trolley system was found impracticable of operation in many of its details, and the single trolley, because of its simplicity and convenience, has made rapid advances in public favor. The single trolley system has depended largely upon the earth and buried pipe systems for completing the circuit.

Many devices for making the track and earth combined a more complete and low resistance circuit have been resorted to, such as burying copper or iron plates, old rails or old car wheels, and connecting same to the track; or, at frequent intervals, driving iron rods down in the earth and connecting by wires to track; or by making actual connection with wire from tracks to gas and water pipe systems.

Also, for supposed reinforcement of the track, we have used a bare wire of iron or copper, buried in the earth, laid parallel to the track, and connected at frequent intervals; also the supposed electrical connection of rails at joints, by bond wires of iron or copper, only having a small fractional part of the capacity of the rail as a conductor.

In the early days of electric railway construction it was assumed by experts that the earth and the buried pipe systems would, when combined, form an ample return for the electric current. At that age of the art experts did not fully appreciate the immense quantities of current that would require to be carried, and therefore did not foresee that these currents when disseminated would produce the serious results that have been caused by electrolytic action on systems of pipes buried in the earth and owned by other companies.

Frequent tests prove that the earth itself cannot afford the free path for the current that was anticipated. Earth conductivity has been overestimated.

Iron and lead pipes, being better conductors than earth, must of necessity carry the current, if no superior path is offered by the method of construction. The natural moisture of the earth hastens the destructive electrolytic action of the current on these pipes. In some soils electrolysis is more rapid than in others. The rapidity of action depends upon the chemical constituents of the soil.

It has been found that illuminating gas leakage held in such soils as underlie the cities of New York, Brooklyn, Boston, Philadelphia and elsewhere hasten electrolytic action.

To prove that the methods of work mentioned are still in vogue, I quote the following section from specifications recently sent out from the office of a prominent electric railway company:

"Each rail shall be connected together by two bonds, made of No. 4 galvanized iron wire (Roebling gauge), to each end of which shall be brazed two nine-sixteenth inch Norway iron rivets. Both of the bonds shall be separately connected with a No. 0 galvanized iron supplementary wire, by means of No. 4 galvanized iron wire connections, which shall receive at least four turns around both the bonds and supplementary wire and be thoroughly soldered to the same. Ground plates shall be placed about 1,000 feet apart. They shall be buried not less than eight feet in the ground, preferably in damp places, and two No. 0 galvanized iron wires shall be brazed to the ground plate and connected one to each supplementary wire in each track, by thorough wrapping and soldering. The ground plates shall be of galvanized sheet iron, two feet square and one-eighth inch thick, bent around in the form of a spiral."

It is evident that electrician had then perfect faith in the earth as a conducting mediums. Evidence had not been produced that Mother Earth was incapable of carrying the enormous quantities of current required; neither had an opportunity been afforded to demonstrate her capacity. That some still have faith in the earth's ability in this direction is attested by above specifications and other constructions being executed at this date.

Having briefly reviewed the practice for the past few years, let us now have a look at the resultant effects. In cities provided with electric railways destructive electrolytic corrosion is now acting upon gas and water pipes, and will inevitably produce serious impairment of all such underground pipe systems within a brief period, unless prompt measures are taken to prevent further damage. Within the past year strong evidence of damaging electrolytic action has been produced.

Simply for the sake of fixing the evidence on your memory I will mention only seven instances of electrolytic action of railway currents on gas and water pipes, in different cities.

First—A section of iron water pipe shows complete perforation, caused in four weeks' time. The lead covering of telephone cables also shows serious damage. A large number of additional items will be found in the report to Board of Electric Subways for 1893.

Second—A plumber in a city in Pennsylvania was repairing a water pipe in a house, and on breaking joint, an electric arc formed across the separating ends of the pipe. This house was not in the direct path of the railway circuit.

Investigation followed, proving beyond question the insufficient electric conductivity of the track system; also that the earth did not afford a good return though the tracks were well grounded. It was found that the rail-

1. Read before the National Electric Light association at the Washington convention, February 27, 28 and March 1, 1894.

way current was traveling all pipe systems in its effort to complete the circuit to the dynamos in the power station.

Actual tests were here made by an expert, using standard instruments. From 135 readings of ampere meter it was found that the feed water pipes leading in the station carried an average current of ninety-three amperes.

Further careful test is proved that with twenty-three cars in operation on the system forty per cent. of the total current was carried on the underground pipe systems.

Third—December 15, 1893, a fire occurred in the basement of James Sutherland's house. After being extinguished, investigation showed that the current of the electric railway system had been carried along the iron water pipe, and that probably by vibration, causing the pipe to come in contact, an arc formed between the water pipe and gas pipe, burning a hole through the gas pipe, and thus set fire to the gas. The house was saved by prompt action.

Fourth—Tests show the electric railway current present on the water pipes. In the generating station the fireman gets a shock when he opens the furnace doors of his boiler with the bare hand.

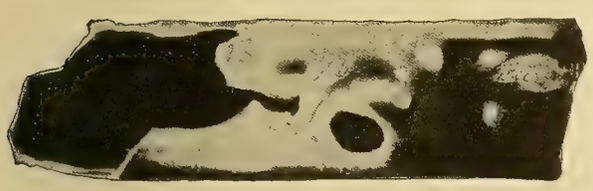
Fifth—A test recently made by an expert engineer developed the fact of a loss of twenty-four per cent. on the system, and a difference of twenty-five volts potential between parallel tracks opposite the power station.

Sixth—Prof. Barrett, in an exhaustive report to the mayor of Chicago, states that "this destructive action is not alone confined to the lead covering of telephone cables, but is acting on gas and water pipes and almost all buried metal work," and that it can only be a question of time when more disastrous results will manifest themselves.

As further and substantial evidence, I here exhibit for actual examination a section of six inch water main from city No. 7. This pipe has been entirely corroded through by the action of the electric current of the street railroad system, which was constructed under my direction about four years ago. This effect was produced in about two and one-half years; another section was rendered useless in six months.

Abundance of additional and substantial evidence can be produced. These serve to prove the case, which cannot longer be successfully denied nor assigned to other causes.

It has been stated that in an electric railway system where a connection has been made to water pipes, the pipes have carried as much as twenty-eight per cent. of



RESULT OF ELECTROLYTIC ACTION ON SIX INCH WATER PIPE.

the total current. Instances are known where as much as forty per cent. is carried on the pipe systems.

It is the opinion of the writer that any gas or water pipe system used as a carrier of electric currents will not only be corroded through the body of the pipes, but will surely in due time show defects at joints, as here will occur higher resistance than in any other portions of the pipe system.

It has been proven by test that the electrolytic action of even five amperes of current on an iron pipe is considerable, and that much damage will result in one year. The rapidity of action depends upon character of soil, amount of moisture and quantity of current; the destructive action is constant and sure.

I do not wish to create unnecessary alarm, but there can be no question that a grave danger confronts us and must be surmounted. Instances are numerous proving that the electric railway current is present on the gas and water pipes in buildings contiguous to electric railway lines. Even those of us who are familiar with handling the electric current hesitate to draw a combination of electricity with our gas or water. We know that the gas and water pipes entering our houses may be charged with such a current, and that it only remains for the circuit to be completed by a possible accident through our bodies, or the occurrence of a fire by automatic action between vibrating pipes. City engineers, water companies and gas companies are placing the responsibility upon the railway companies for the damage caused on pipes by electrolysis.

Any system using ground plates, ground rods or substitutes therefor, or bare return track wire buried in the earth, is constructed primarily to utilize the earth as return circuit; when the earth does not afford a good return the current is sure to follow the water pipes, gas pipes or other buried conductors offering the path of least resistance. We now see that these prove to have been only make shift methods to reduce the cost of construction. We find that the evidence thus produced and the troubles constantly occurring in existing street railway systems are sufficient to show that all methods of grounding the track circuit or connecting to pipe systems should be entirely discontinued; it therefore becomes of vital importance to so construct the electrical railway system as to avoid all electrolytic action on buried systems of metal work that are the property of other concerns.

Having produced the evidence and established the case, let us briefly analyze the matter and ascertain the reason for these results.

The whole case may be stated in the single sentence—that the electric current must under natural laws follow the path of least resistance. What was intended to be good has proved to be defective electrical work executed in connection with track systems, has not given to that side of the system a perfect path for the travel of the current; the conductivity of the rail circuit being impaired to such an extent that the electric current must force itself through the earth or through metal pipe lines buried therein.

We must here diverge for a moment to show how the incandescent electric light system operated in multiple arc compares with the railway system.

The systems otherwise differ in important particulars; the load on the electric light system is not subject to such violent fluctuations as on the electric railway, where the instantaneous demands for current and its equally prompt release must be controlled. The current required for the car is a moving load as the car progresses on its route; this and all other differences of conditions must be duly considered when laying out the system of distribution. With the electric lighting system, the current for consumption is derived from the mains, the equalization of pressure is maintained through the feeders, the mains are of equal capacity on either side of the system.

With the electric railway, the track forms one side of the consumption circuit, and must be so treated in regard to distribution of current as to utilize its carrying capacity equally with the other side, and thus equalize the delivery of current. The electric conductors composing a system of distribution for electric railways should be so thoroughly well proportioned as to show the minimum variation of pressure throughout the system, even when the entire number of cars are in operation. This equality of pressure is an important requisite for the economical working of motors. The writer has tested electric railway systems operating with a station pressure of from 500 to 550 volts, and showing only 300 to 325 volts on various divisions of the system. Here is a direct loss between dynamos and motor car of over forty per cent. Is it therefore any wonder that some roads report extraordinary coal consumption? Such loss in pressure indicates radical faults in the original planning of the system and the distribution of copper. When operating under low voltage, the motors demand an increased quantity of current above what should be the normal supply, thus augmenting the heating effect in the armatures and fields, the efficiency of the motors being reduced in corresponding ratio.

A further examination into other features of construction requires some consideration of the bonding of rail joints.

The existing methods of utilizing railway tracks for conducting large quantities of current are faulty in at least three particulars:

First—Restricted conductivity at joint due to insufficiency of the rail bonds.

Second—Neglecting to properly utilize the track as a conducting medium.

Third—Failure to provide a complete circuit of low resistance.

For electrical purposes we cannot regard the joint plates and bolts as of any permanent value; the contact is electrically imperfect, the metal surfaces oxidized and under constant movement, due to passing cars pounding the rail joints.

The rail sections are in many systems of ample conductivity to carry more than the requisite current, provided they are perfectly bonded and properly connected by feeders with the dynamos.

We must, therefore, bond the rail joint in such a mechanical manner as to maintain perfect electrical contact, and with sufficient metal to restore at the joint nearly the full conductivity as of the rail itself, and at the same time to give the existing joint plates their present freedom of motion.

It has been found that a system of track with faulty rail bonds will give a shock to animals and, possibly, to human beings should the same be brought into actual contact in such a manner as to complete through them the broken circuit.

It will be readily understood how difficult it is to maintain proper inspection of electric bonding where the bonds are covered up by the street pavement.

Under such conditions the ground circuit and the bonding escape inspection until excessive coal consumption, loss of current and other troubles force themselves upon the attention of the street railway management.

Observation proves that a faulty rail bond will show its location in winter by heating, due to high resistance, and if snow be present on the ground around the joints the snow is partially melted, thus indicating location of fault.

Let us turn our attention for a few moments to the question of the conductivity of the rails.[1]

For the purpose of comparison we will assume that iron has six times the resistance of copper. (The actual proportion is 1 to 5.63.)

	56 Pound Rail.		70 Pound Rail.	
	One Rail.	Single Track of Two Rai's	One Rail.	Single Track of Two Rails
Area in sq. in.....	5.4874	10 9748	6.8593	13.7186
Equal in area to to circle whose diameter is in inches	2.642	3.735	2.95	5.90
Equivalent in cir. mils to	6,980,000	13,960,000	8,702,500	17,405,000
Resistance per foot B. A. units,.....	.00000845	.00000422	.00000679	.00000339
Equivalent to copper resistance in cir. mils....	1,175,000	2,350,000	1,463,000	2,926,000
Equivalent to copper rod whose diameter is.....	1.13	1.533	1.21	1.71
Safe carrying capacity of iron reckoned at ⅓ that of copper in amperes...	390	780	488	976

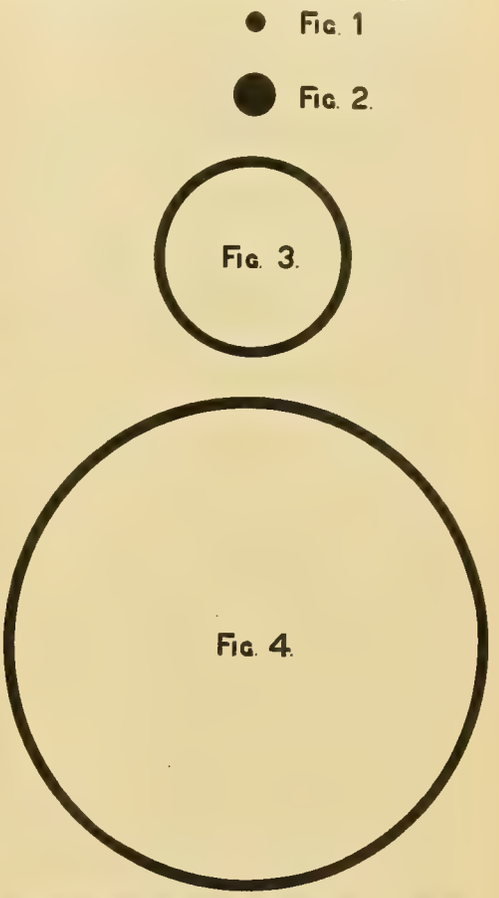
NOTE.—In the above statement the areas of rails have been determined by use of the planimeter. The ampere capacity of iron has been based upon the most reliable data obtainable. The author believes that the figures submitted are sufficient for comparisons, but cannot guarantee their absolute accuracy.

1. Table prepared by G. F. Sandt, E. E.

The following table gives, from data furnished by A. E. Kennelly, the current strength that can be carried by iron wire, within doors, in still air, and without becoming unbearably warm to the hand; that is, not to exceed a temperature of 50° Centigrade:

B. & S. GAUGE.	AMPERES.
10	16
9	19
8	21
7	25
6	28
5	32
4	37
3	43
2	50
1	58
0	67
00	77
000	90
0000	105
½"	117
¾"	203
1"	302

These figures serve to show how utterly absurd it is to bond a track of seventy-pound T rails with iron rail bonds No. 4 or No. 0 in size, and to pretend to reinforce their conductivity with a No. 0 iron or even a No. 0 copper wire.



THE IMPORTANCE OF COMPLETE METALLIC CIRCUIT FOR ELECTRIC RAILWAYS.

It is like laying a twelve-inch water main and then putting a one-half-inch pipe alongside to help it out.

The No. 0 B. W. G. copper wire has a resistance of over twenty times the single track of fifty-six pound T rails per foot, and the No. 0 B. W. G. iron wire over 112 times the resistance per foot of the same track. How, then, can either of these be of any adequate assistance for conducting current?

The following diagrams indicate the small value of a supplementary wire of either iron or copper when compared with the conductive capacity of a properly bonded single track of fifty-six pound rails.

All the areas are in accurate proportion for comparison.

Fig. 1 shows the area of a circle indicating the single track of fifty-six-pound rails. Fig. 2 represents the iron reduced to resistance of copper. Fig. 3 shows the No. 1-0 supplementary copper wire and Fig. 4 the No. 1-0 supplementary iron wire reduced to resistance of copper.

The writer knows personally of several instances where the copper supplementary wire has absolutely disappeared.

The writer believes that ninety-nine per cent. of the money suspended for so-called supplementary wire is absolutely thrown away. The same money expended in other directions will give more adequate return.

Does not this show conclusively that we should give our attention to the more perfect bonding of the rail joints, and also to apply track feeders in such a manner as to fully utilize the conductivity of the track and thereby make it fulfill the service of which it is capable when properly treated?

We are in error when the track system is named as a return circuit. The track system of all electric railways should really be the positive side or out-going circuit.

It will be readily understood that as the current travels from positive to negative, therefore, any arc which occurs

[*Continued on page* 119.]

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IT was generally remarked at Washington last week that the representatives of the electrical interests were much more hopeful of the commercial outlook than they had been for many months, and they were correspondingly happy.

THERE appears to be a fair prospect of a large extension of electric railway lines in Chicago—one that will attract the attention of electrical railway men all over the country. The Chicago City Railway company has been endeavoring for some time to secure permission to change the motive power of its cross-town lines from horses to electricity, employing the overhead trolley system. On Monday evening the city council passed an ordinance providing for the change on the tracks of the company on 22d, 26th, 31st, 39th, 51st, 79th streets; Archer avenue, from the State street intersection to 38th street, and thence on 38th street to the end of the line; 43d street, from the eastern terminus of the line to State street, thence along State to Root, thence along Root to the end of the line; on Halsted street from Archer avenue to the southern terminus and on Wentworth from Archer avenue to the southern terminus of the line; Ashland avenue, from Archer avenue to the southern terminus, and Hanover and Wallace streets. State street, by the ordinance, will also have its trolley south of 63d street. Indiana avenue was excepted. There has been much opposition to this improvement, and we hope that the company, should the ordinance receive the mayor's approval, will provide first-class construction. The result will be an object lesson of great value to the people of Chicago.

CONSIDERABLE space is devoted this week to the report of the meeting of the National Electric Light association at Washington. It will be noticed that the subjects discussed covered a wide range and did not in all cases directly bear upon the lighting interest. Mr. Vail's paper, for instance, was purely a street railway man's contribution, and while the subject was one in which there was general interest, yet it is questionable if such papers should be introduced to the exclusion of others of more importance to the lighting interests. It seems hardly fair to prolong the meetings and require members to remain an additional day in order to complete the programme after devoting an entire morning to the reading and discussion of a paper that does not really pertain to the lighting interests. It is to be hoped that the committee on papers and programme for the next convention will not be quite so ambitious as that which made the arrangements for the Washington meeting. It would be much better not to attempt so much and do it better.

President Armstrong, in his annual address, discussed the question of municipal control of lighting plants, and it was evident from his remarks that he had not changed his views upon this subject. There is no doubt that he expressed the views of a vast majority of the members of the association, as was shown by the hearty applause which greeted his vigorous denunciation of the policy of the parent companies who have encouraged municipalities in the establishment of public lighting plants. If further evidence were wanted to sustain this view, the election of M. J. Francisco as president for the ensuing year would prove conclusively that the opponents of municipal control are in power in the association. It may be said that they have gained considerable strength of late and that many of the old members who took an active part in this matter a few years ago were on hand and took part in the proceedings, exhibiting as much interest as in former years.

There was much comment on the fact that the claims of the West for recognition were again passed when the selection of officers was made. Many of the more conservative members expressed disapproval at the policy of the management in transforming the association into an eastern organization.

MANY of the visitors to Washington last week who attended the convention expressed surprise at the inadequate facilities for lighting the grounds and public buildings of the city. This matter has been brought forcibly to the attention of the United States Senate by Senater Manderson, who succeeded in securing the passage of a resolution directing the secretary of war to investigate and report to the Senate the feasibility and advisibility of using the water power of the Great Falls or other water power in the neighborhood of Washington for the purpose of lighting by electricity the public buildings, grounds and streets of the District of Columbia. This report shall suggest the method by which the right to use the water can be acquired and what steps should be taken by legislation or otherwise to acquire the water power and the needed land adjoining. The secretary is also directed to submit a general plan of the electric plant needed at the falls and of the wires needed between the plant and the different parts of the District and an estimate of the cost. He is also instructed to furnish an opinion whether this power will be sufficient to furnish light to private consumers within the District and to suggest the terms and regulations under which it should be so furnished. This resolution is the outcome of a careful investigation of the subject instituted about a year ago by the committee on rules. Senators Blackburn and Manderson were authorized to make a thorough inquiry into the needs of the buildings.

Senator Manderson, who has given especial attention to this subject, is reported as saying that it would require an expenditure of $200,000 to put the present plant into good condition, and even then it would not be sufficient to supply current for all the public buildings and grounds. Continuing, Senator Manderson said: "We have, very near the city of Washington, a water power that is almost unexcelled by any in the country, and it is somewhat amazing that capitalists and men of enterprise have not made use of the Great Falls of the Potomac for some useful purpose. Beyond a peradventure that is the place to erect an economical and effective electric plant. There is undoubtedly power enough there to light not only all the public buildings of the city of Washington, but the streets as well. I do not know but that there is sufficient power, perhaps, at the Little Falls of the Potomac, which are nearer to the city, that might well be used for that purpose." It is to be hoped that this subject be carefully investigated. At the present time the public buildings are depending almost entirely upon gas for illumination, and those engaged there find considerable discomfort and annoyance under the present arrangement.

THE Legislature of New York has an unusual amount of legislation under consideration this year affecting telephone companies. Four bills of this character have been introduced in the Assembly, and are now pending before the committee on electricity, gas and water supply. The first of these, introduced by Assemblyman Houghton, provides that telephones shall be furnished to all applicants at a price not to exceed $75 per year in cities of over 500,000 inhabitants; in cities under 500,000 inhabitants for $50, and in towns and villages under 10,000 inhabitants at $36 per year. The bill also provides that there shall be no mileage charges unless the distance from the central office is over five miles long. Long-distance rates are fixed at 10 cents for a distance of ten miles or under; for any distance in excess of ten miles and not over fifty miles, ¾ cent per mile; for any distances over fifty miles, ½ cent per mile. The limit of conversation is fixed at five minutes. The second bill was introduced by Mr. Cahill. It constitutes the comptroller, attorney-general and state engineer a board of telephone commissioners, and provides that they shall hear complaints of excessive charges and "shall fix and declare such rate or rates as shall produce a net profit" of ten per cent. on the cash capital expended, invested and employed in the business. It is provided, further, that such rates shall remain in force for one year. The bill gives the commissioners power to compel the production of books and papers. The third bill was introduced by Mr. Dinkelspiel of New York. It fixes telephone charges as follows: $85 per year in cities of 300,000 inhabitants, and in smaller cities rates not exceeding those charged on January 1, 1892. The fourth bill, which was introduced on February 23d by Mr. Gerst of Buffalo, provides that telephone charges in cities of 1,000,000 inhabitants shall not exceed $85 per year; in cities of 500,000 inhabitants, $66; in cities of 100,000 inhabitants, $48; in cities of 20,000 inhabitants, $36; in cities of 8,000 inhabitants, $30; and in smaller cities and villages, $27. Section 3 of the bill provides that if such charges will not yield a profit of 10 per cent. complaint may be made within thirty days to a board consisting of the comptroller, attorney-general and state engineer and surveyor, and these officers are required to make a thorough investigation and within six months shall fix the rates, "provided that such rates shall not produce a net profit in excess of such sum as is required to pay the interest on its bonds and 10 per cent. upon the cash capital actually paid in by stockholders, which cash capital from bondholders and stockholders shall have been expended and employed in its business and necessary to the efficient rendering of its services." The bill provides that the rate fixed by the three state officers shall be binding on the company and shall remain in force for one year. The three officers may employ assistants, who shall take oath that they are not employed by any telephone company and have no investments in telephone stock. The bill also provides that the companies shall furnish the most approved appliances and shall make sworn reports to the state officers each year; also that the expense incurred by the board shall not exceed $10,000 a year; that this shall be paid in the first instance by the state treasurer, but that the total expense shall be borne, according to their capital, by the telephone companies. It is further provided that the three state officers shall report annually to the Legislature. Provision is made for the infliction of severe penalties for violation of the act.

There are many admirable features in these bills, and it is probable that the committee to which they have been referred may combine them. In Mr. Gerst's proposed measure it is provided that assistants be employed, but they shall be required to make affidavit that they are in no way connected with or interested in telephone securities. It will be hard for the state to find competent telephone experts who are not retained by the Bell interests or some of the companies now competing with the old concern.

The Importance of Complete Metallic Circuit for Electric Railways.

[*Continued from page* 117.]

between the trolley wheel and the trolley wire will carry metal from the trolley wheel and deposit the same on the trolley wire. If the reverse method of connection is made, the trolley wire will lose the metal, the same being deposited on the trolley wheel, and in time the strength and conductivity of the wire must be seriously impaired, eventually resulting in breakages.

It is also important that existing systems of operating electric railways should be promptly taken in hand and the proper remedies intelligently applied.

The three-wire system has been mentioned by some engineers as a possible solution.

I will here diverge for a minute to state that a trial was made four years ago under favorable conditions—not to avoid electrolysis, but to save copper. We developed physical difficulties of operation which warned us to avoid the three-wire system in future electric railway work.

I believe I am safe in stating that ninety per cent. of the electric railways have their systems so constructed as to largely restrict the conductivity of the rail circuit.

A one-sided system is fundamentally wrong. The quantity of current to be controlled is so enormous that ordinary make-shift methods will not answer.

Having carefully analyzed the whole matter, I feel justified in recommending that we must adopt the complete metallic circuit as the standard for the best electric railway practice. This can best be obtained by the following method:

First—By so bonding the track as to render the rail joints of as low resistance and nearly equal conductivity to the rails; and to execute this work so as to maintain this improved condition; and

Second—The track system must be supplied with insulated feeders leading direct from the bus bars in the station to predetermined points of the track system, and thus offer a perfect low resistance path for this side of the electric circuit, the same as is obtained with the trolley line and the overhead system. All of these features and improved methods have been put in practice by the writer.

The only proper system is one that affords a well insulated and complete metallic circuit of low resistance, that will give an ample path for the complete unrestricted circulation of the entire current from pole to pole of the dynamo, thus offering no inducement for the current to follow such conductors as gas or water pipes, but, as it were, actually robbing the earth of any desire to carry the current. I am not recommending extravagant methods, but only such as are deemed essential for economy, and of a practical nature for reducing expenses and augmenting dividends. The item of cost cannot properly be urged as an objection, because where the whole construction requires a large investment, every detail of the work should be so executed as to be permanent and enduring. If the details are carefully analyzed it will be found that the cost of frequent reconstruction, maintenance and renewals of rail bonds and bare wire amount to an excessive rate of interest on original investment, and would soon pay the small additional cost to build a complete metallic circuit. The surperior service obtained from a complete metallic system of low resistance with the proper application of insulated track feeders will, within a brief period, more than refund a reasonable interest on the investment through the saving of fuel alone, not counting other economies in renewals and maintenance. The track feeder system will be far less costly than the double trolley system.

Whether track feeders should be laid underground or erected overhead is a question largely controlled by local conditions and capital available. I express a preference for underground work as being more permanent and subject to the least cost for repairs. The original construction is certainly more costly for underground. The actual cost of copper is the same in either. The necessity of constant repairs under existing methods, and the damage to water and gas pipes by electrolytic action, simply proves that it is but a question of time as to how long before electric railway companies will be forced to adopt the complete metallic circuit. Where experience and practical knowledge is applied, the cost will not be excessive. It is not difficult to arrive at an exact method of doing the work and an accurate estimate of its cost.

The writer has observed on some roads that large quantities of copper for return circuits have been placed at great expense, apparently without a proper conception of how to obtain the best results. Frequently a far less amount of copper, judiciously applied for improved distribution by the feeder system, would give superior equalization of pressure at reduced cost.

If for the movement of cars singly or in quantities at a high rate of speed the electric current is to be distributed uniformly over an electric railway system, the subject must be handled with as much scientific accuracy as is always used for a perfect system of incandescent lighting, in order to obtain equal distribution and free flow of current in both sides of the system.

The writer has provided for all contingencies in the following manner:

First—By a careful study of the conditions under which a system will be operated; these important points being ascertained with reasonable accuracy, the requisite supply and distribution of current for the service is determined, and the system of conductors arranged to meet the requirements. For the proper supply of electric current, the important underlying principles of the feeder system must be thoroughly understood.

Second—The conductivity and current-carrying capacity of the track system is calculated, and a system of insulated track feeders is provided, leading from the switchboard in station and connecting at predetermined points, and with a calculated fall of potential.

Each feeder must be determined for its maximum current requirements at a stated drop in potential. The actual work required of the feeder and number of track feeders necessary is determined upon such factors as: The cars in service—their weight, speed and headway; the position of power station and the geographical lay of the railway system; the weight of rails, and whether double or single track, and the amount of load concentrated on sections of track between feeder junctions.

The carrying capacity or conductivity of the sum total of all the feeders of the system will be found to give complete and ample circuit for the free flow of the entire current required, and to take care of extra heavy traffic and blockades at any point.

The parallel track main is only applied in sections of systems extending over very large territories and long distances.

The conductivity of the rails is calculated with as much care as the overhead system, and when the track needs reinforcing the purpose is accomplished by laying a thoroughly insulated main line (not a bare line) and making frequent sub-feeder connections bonded to the track. If used at all this main will be of large size.

Such a system, accurately worked out, will show by actual test with instruments on the cars a surprising equality of electromotive force throughout a large territory.

A very careful test has been made with instruments on moving cars, throughout a system covering forty miles of streets, with double tracks, equal to eighty miles single track. The readings showed—maximum volts, 512; minimum volts, 420. Average of electromotive force over entire system, 460 volts, the electromotive force in station at bus bars, being 520 volts. The feeders were calculated for ten per cent drop, The actual average drop from dynamo to moter does not exceed twelve per cent.

This will be found to result in reduced fuel consumption, better working of the motors, a most satisfactory reduction in repair accounts and an improved general economy of the entire system.

In the system of distribution secured by the above method, the use of ground plates, rods or other insufficient methods is needless; the current travels only over the paths provided for it, and electrolysis of gas and water mains is entirely obviated.

Discussion.

Mr. Burleigh: Do you regard the ordinary six bolt fish-plate as used with the T rail, of any value in bonding?

Mr. Vail: Whether it be a T rail or a girder rail, I do not regard a fish-plate of any permanent value in bonding at all. The surfaces become oxidized and after the track has been in use for some time the joints will give way and there is a leakage in the current. The object of my rail bond is to provide a flexibility in the joint which cannot be broken by any movement of the cars. It is also to allow that freedom of motion at the joint, and to confine each end of the bond to its original connection to the track so that the track may move, but the ends of the bond cannot. You will find on examination of the ordinary bond that in time, when a movement takes place the rail ends break, and as soon as that fracture occurs electrolysis sets in under the break and gradually eats them away.

Mr Smith: Has Mr. Vail had any experience with the welded joints or fish plates and with what results?

Mr. Vail: I have not had any experience with welded rail joints, and I think there are many physical difficulities in the way of that, which will prevent its success.

Mr. Smith: My reason for asking the question was that a gentleman from Boston told me a few days ago that they had perfected the system of welding rail joints, especially as they welded them on the fish-plates instead of on the rail itself.

Mr. Wason, Cleveland: President Moxham of the Johnson Rail company, which did the electric welding on the road of the West End Company in Cambridge, informed me recently that his company was inclined to give up the idea, but was urged on by the West End company, and now he thinks the company has got something which will prove efficient. In my humble opinion rail bonds will never do away with electrolytical action. It must be done by a continuous rail, of the ninety pound section, which most of the street railroads are putting down. That, as Mr. Vail told you, will undoubtedly take care of almost all of the street railroads now running. Possibly in some sections supplementary feeders will have to be used.

Mr. Law, Washington: I agree with Mr. Vail in all he has said about making his track as complete a metallic circuit as possible. There is evidently a great loss of current in all street railways from improper bonding. From the manner in which these bonds are placed in the track at the present time it is impossible for it to be otherwise, and after a short time there is a heavy leakage between the bonds and the rails.

Mr. Vail has assumed that there are only two systems—the overhead and ground trolley and the overhead metallic circuit trolley. There is another system in successful operation—the metallic underground trolley, wherein the track and rail do not figure in the circuit at all; both positive and negative wires being entirely of copper from generator to motor. Such a road as this has been in operation in this city for one year and in Chicago for two years.

Mr. Cuttriss, New York: These electric railroad currents that are now beginning to be so dangerous to the water and gas pipes in cities have been a great source of mischief to telephone and telegraph companies for some years. I am connected with the Commercial Cable company of New York. The Commercial cable lands at Coney Island. We go underground from there into the city and back to the sea. Three years ago they started an electric road to Coney Island, and we immediately began to have trouble. For a long time we could not discover the source, but finally determined that it came from the electric railway. Never again will any telegraph company be able to get a natural and pure earth until the electric railroad systems get a metallic return instead of a ground return. I do not care how perfect the rail connection may be made, unless it is a metallic circuit, there is sure to be such seepage as to seriously interfere with all telegraphic business. We have an underground cable running from the Bronx river, some twelve miles from the center of the city, and about two years they started what is known as the Huckleberry road. Before they started the first car it was all right. Within an hour after running the first car the difference in potential had risen to ten volts. We hope to have the gas and water companies with us in our efforts to have this state of affairs remedied,

Mr. Brophy: I have noticed for a good while in Boston the destructive effects of the currents escaping from the street railway rails. I am familiar with their efforts to weld the rails. I do not believe it will be a success. There must be a sufficient conductivity in the rail and in the bond, if it has not sufficient return wire laid parallel with the rails. On the road between Boston street and Charlestown street in Boston I can say that there is no rail laid to-day that is sufficient to take the return current that is required to propel cars there. Other means must be substituted. They are already using overhead conductors, but they have not been put in properly and they have not remedied the evil. We can there at any time get a difference of potential between gas and water pipes. All we have to do is to put a voltmeter in circuit. In many cases we have had a difference of potential between the hot air furnace tubes in the house and the water pipes, simply because they have come in contact with either the water or gas system in the house.

Mr. Smith: A great deal of the trouble that Capt. Brophy speaks of in the current jumping from the railway circuit is due to the fact that the joint of the rail is very much weaker and less able to stand the strain of the wheel passing over it. A street railway company constructed a mile of track in which no space was left between the rails at all, and used extra long fish-plates and riveted the rails together with six rivets on a side. The company then filled the space between the rails with earth, just below the top of the rail, leaving room for the flange of the wheel, and the track walkers, instead of using a wrench, shoved it along. They could not see the slightest difference or movement in it between summer or winter. They allowed slipping joints of three feet at each end of the track and could not see any appreciable movement. The explanation was that the track being covered up with earth was protected from the weather. It seems to me if we can get a thoroughly welded joint on a street railway track it may stand.

Mr. Wason: Two years ago our road put in about 1,200 feet of track in absolutely the same manner that Mr. Smith has described. I have noticed this track when the thermometer was below zero, and also in the hottest weather in summer, and it has stood without any appreciable movement.

Mr. Wright, Philadelphia: It has been proposed by some of the electric companies that in the neighborhood of the railway power station they be allowed to make good electrical connection, by means of conductors, to gas pipes. I had a case in a western city where it was found that very extensive deterioration had occurred in the gas system, and, bringing the matter before the city engineer and the electrician of the road, they proposed this plan. I think it would be well to warn the members, especially those who have any gas connections, against the adoption of any such make-shift plan. It might obviate the electrolytic action in the neighborhood of the station, but the current will find other paths at a greater distance from the station, and the general effect will be the same. I notice that it is proposed by the English Board of Trade to place certain restrictions on the railroad companies to compel them to put in an insulating screen in the neighborhood of their stations to protect the gas and water pipes. I think the experience so far has been that the most destructive action has been in the nighborhood of these stations.

Storage Battery Car in Chicago.

A record has been kept of the running of the car operated by storage batteries on Twenty-second street, Chicago, a description of which was published in this journal some time ago. It shows that the car averaged 50 miles a day upon a single charge. Hitherto there have been no facilities for charging the car except from the trolley line now operating upon Twenty-second street, but arrangements have now been made by the storage battery people so that the cells may be charged independently of the trolley system. When this is done, the car will be put in constant daily operation and a much better result than that already obtained is expected to be attained. During the recent blizzard the trolley cars on Twenty-second street were practically obliged to stop running, but the storage battery car, so the officials of the company state, did not miss a trip.

It is proposed to light the Hay Lake channel, near Sault Ste. Marie, Mich., by electric lights. The plan as now contemplated is to run electric cables from the Soo on each side of Hay Lake channel, with connecting submerged eables, to each of 56 electric lamps or buoys, situated on either side of the channel, 28 on each side, the lights on the north side to be red and those on the south side to be white, and the lights of each side to be independent of the other side. If the plan is found feasible it will be recommended to the light house board for adoption.

THE CONVENTION

Of the National Electric Light Association at Washington, D. C.

The seventeenth convention of the National Electric Light association was held at the Grand Army of the Republic Hall, on Pennsylvania avenue, Washington, D. C., February 27 and 28 and March 1, 1894. President Armstrong of Camden called the convention to order and read the following address:

THE PRESIDENT'S ADDRESS.

In opening the session of the seventeenth convention of this association, I might be counted remiss did I fail to congratulate you specifically as well as generally. And I find myself constrained to preface this with a note of regret. It was my hope and purpose to have this session held in Philadelphia, where, being at home, we could have an enjoyment in some degree commensurate with our past experiences of those social attentions and attractions which have made our sessions famous. But in the midst of all our pleasurable experiences in this line there has been running continually the admonition that this must be ended; but after Providence we had Montreal; after Montreal we had Buffalo; after Buffalo we had St. Louis; and indeed it seemed as if perfection was being perfected. With this in view, then, your executive committee with practical unanimity overruled my Philadelphia suggestion when I made it, and those present as well as the absent ones who communicated with us fixed upon this beautiful city, which, while it was no man's city, was nevertheless everybody's. Your meeting here, therefore, means that henceforth what has been such a delightful and enjoyable portion of our sojourn at various places must be curbed and limited and we must restrain the social and entertaining part for fear that it will, after a while, interfere with the sober and serious, and we must save more of our time and energy for the especial business and affairs of our association. The unanimity of our membership in favor of the National City for our meeting place spoke well for a successful convention, which, from our attendance and our programme, will be fully realized.

Had we met in Philadelphia, we would have been in that city which is not the least famous in all her rich historic legends for having been the place of residence and the final abode of the mortal remains of that noble old patriot, philosopher, philanthropist, our patron saint, Franklin; within the sight of that old State House from whose council chambers went forth that brave message to the opinions of mankind, which shall be sounded so long as the liberties of man are known; in near touch to the old hall of the Carpenter's company, where the Congress sat; on the banks of the American Clyde; in a great religious, intellectual, political metropolis. But you didn't. You see I want to make you all sensible of your loss.. I am like that Irishman who had been pounding the head of a snake until it was a jelly, and still kept at it. A bystander remarked, "What are you doing, Pat; the snake is dead." "I know it, bedad, but I want to make him sensible of it." The wiggle of the tail, he thought, betokened a lack of sensibility. Besides all this, you, the disciples of Ajax, the devotees of lightning, the sons of thunder, not only would have been in the city where the late Mr. Franklin drew from the lowering black thunder clouds and stored in a bottle some of that mysterious force which had been ever since first its thunderous tones had been heard and its vivid flashes seen the tenor of mortality, but right across the majestic Delaware, easily accessible by the payment of the small export duty of three cents, lies the fair domain of Nova Cæsara, later corrupted into New Jersey, and by some irreverent persons designated by nomenclature that I shall not deign to mention. This region is famous for a brand of electricity that in all the broad domains of our wonderful science has no equal. The winter's snow and summer's sun, spring's laughing kisses and autumn's wails and tears, all blend for its generation, and after the press of necessity and the fires of application have done their work, and the life of the apple has assumed that pale scholastic appearance all of you so well know, and it is placed in its storage battery and properly insulated with a cork and placed away out of the sight and reach of men, it goes on gathering up force and strength, and, unlike all other electricity ever I heard of, the older it gets the more deadly its effects, so that I have heard of Jersey lightning killing at forty rods. But all this you have missed, and I must proceed to my congratulations. No one gives us the usual address of welcome, because we come to our own.

You and I own this city. It is with a pardonable pride that every American enters it. Not alone for what it is, but for what it represents. It is not a typical American city, but it is typically American. Beauty and embellishment have nowhere been sacrificed to utility. It is as broad, as generous and as comprehensive as our country. The magnificent capitol and the other government buildings, the monuments, statues and parks, the avenues and boulevards,are all as generous as we Americans could ask.

Rich in its historical and its past governmental relations, it maintains the same spirit in the present. Go to yonder hill and see sitting the selected servants of 70,000,000 people. It is the grandest assemblage to whom the problem of government was ever entrusted. Its greatness is in what it is—in the present—not in its past, glorious as that is. I speak advisedly. Notwithstanding the slowness with which (as we believe them) good enactments have been delayed—and oh! how slow they were; the proverbial speed of the snail was as a lightning express compared with it—and the unrighteous haste with which (as many of us also believe) a very bad system of legislation is about to be enacted, still I repeat what I have said. They are doing only what their masters, the American people, more than a year ago in haste and thoughtlessness, let us hope, not in anger, bade them do. But whatsoever they do you and I, if we believe in representative government, are doing. And therefore I, as one entirely and absolutely out of sympathy, as you all well know, with the present political belief of the government, executive and legislative, can with even greater propriety bid you behold, respect and admire what you here see.

I must not delay, however, to tell you all that impresses me whenever I come into the beautiful American capitol, believing as I do in the essential perfection of our American systems. Feeling that there is danger that I may permit my zeal and enthusiasm to run away with me when I regard these things, I will have to pull myself up short and say that I welcome you to your own.

The past year has been a very trying one on electrical enterprises. As we are among the settled businesses of the country the newest, and therefore the most elastic, we have felt the financial stringency, the oppression of the times, worse than many others, but we have not been without cheer and encouragement during it all. If my figures are correct, and I have tried to obtain them from the most reliable sources, there are now upward of 2,300 central stations in this country, representing at least two hundred millions of capital. Involved in electrical manufactures and supplies of various kinds are as many millions more; this employing, as it naturally does, hundreds of thousands of men; supporting hundreds of thousands of homes; adding to the material wealth, prosperity and happiness of our people, makes us as representatives, trustees of a great and responsible trust. This is a growth practically of the last decade. He would be a brave man indeed who would dare even to suggest the limit of the possibilities of the use of electricity for great and important works. Night has been turned into day and the industry of man is applied for the full twenty-four hours of time, and the days therefore are multiplied by just that much; distance is annihilatad, so that last summer, I, while being a thousand miles away, enjoying the beauties of that wonderful White City and drinking in the lessons there taught, was still within speaking distance of my office.

These wonders and marvels, for wonders and marvels they are, are only valuable in so far as they add to the comfort and happiness of the world; that they do, none of us will deny, and therefore, as I call your attention to the business that has brought us here together, do not accuse me of making use of hyperbole, when I say to you, that you do not meet merely as representatives of business enterprises, merely as representatives of so many millions of dollars, invested in dividend producing concerns, but as the representatives of an industry, a science, that means benefit to the race; that means more health, more happiness, more encouragement, more comfort to fellow-men. In the highest, truest, best sense we are representative benefactors.

The history of the past year has not been varied, except for the rocks and difficulties to which I referred, from the history of those that have preceded us. There has been a tendency in the last few months, however, for a revival, largely instigated, I am afraid we will have to say, by the representatives of our large manufacturing corporations, of the agitation of municipal ownership of electrical light plants. I sincerely believe that to be a bad policy for the city, as I have always maintained. I believe it to be a worse policy for the manufacturing concerns that advocate it. But no city can ever afford to do an unfair thing. Municipal ownership has been somewhat more earnestly revived in our section of late than it has been for many years, and I propose to trespass on your patience long enough to read here an editorial that appeared in one of our fairest, most outspoken and distinctively representative papers, the Philadelphia *Public Ledger*, upon this question:

"*A Municipal Electric Light Plant.*

"The long considered project for the establishment of a municipal electric light station has at last taken definite form, the mayor and Director Beitler having asked city councils to make an appropriation to provide an electric light station for street illumination. The general proposition that the city should own its own plant for the lighting of streets, just as it should own the gas and water works, is sound in principle. But the city is not now free to do this without considering as a matter of simple equity the privileges which it has given to existing corporations, and which it would in large measure withdraw if it should now enter the business in territory already occupied. In 1883 the city was entirely free to go into the businees of electric lighting, but it did not choose to do so. The cost was great; there were many practical difficulties in the way, and the financial results of such an undertaking were uncertain. The city at that time held back from what was more or less a venture, and gladly welcomed the offer of certain capitalists to undertake the work at their own expense. Thus a part of the city was lighted by electricity through the enterprise of a corporation, the city paying for the street lights that were furnished. The business was gradually extended, other corporations lighting other sections, until the number of electric street lamps had increased from 49 in 1883 to 3,427 last year, and the expense from $15,000 per annum in 1883 to $624,376 in 1893. In the meantime the amount of money invested in the plants required to furnish these lights had grown proportionately. Millions of dollars have been expended in the development of a business which the city declined to engage in until the pioneers had cleared the way and established the fact that it could be made profitable. If now the city should engage in electric lighting and withdraw from existing corporations the street lighting, which forms the basis of their business, it is easy to see that the men of enterprise, who gave us the advantage of this improvement ten years before the city was prepared to do so, would be left with unprofitable plants upon their hands. This would not be fair. The city is justified in trying to get back that control of street lighting which it should never have surrendered, but it is bound by the principles of equity to do so with proper regard to the interests of those who have developed the system and whose money is now invested in lighting stations. It is true that the city, in establishing new lines of its own, does not take tangible property of the corporations; if it did so, it could be compelled by law to make just compensation; but it does what amounts to the same thing, if it takes the business whereby the corporations live.

"The city cannot afford to do an injustice of this kind, though it may have the right to do so; nor is it necessary to do such injustice in order that the city may assume its proper function of supplying its own street lights by electricity. It can make its experiments in districts of the city not now lighted by electricity, and if it finds that it is desirable to go farther than this, it can (probably with advantage to the treasury) buy existing plants, after it has ascertained their true value, instead of unnecessarily duplicating those now in existence.

"The whole subject needs careful consideration and the purpose should be to give the city control of the electric light works at fair cost, without injury to its own citizens, who have, by their enterprise, promoted the city's interests by advancing their money for its improvement. Municipal corporations are most like good business men when they are guided by high principles and seek the right by right means. And in this matter of municipal electric lighting progress can best be made by paying due respect to vested interests and seeking to accomplish the desired results without injury to any one."

I have read this editorial because it sounds the proper sentiment; and every municipality that is honest, every government that is honest, every man that is in authority who is honest, must have due regard for every dollar that is invested in a business, whether of a corporate or private nature; and this unholy, this infamous, communistic warfare on these enterprises, not alone upon us, but upon kindred enterprises, is something that is distinctively antagonistic to the principles of our government, to the principles of our institutions and to the principles of fair minded business equity; and I tell you, whenever such principles are suffered to gain a foothold in any part of this continent, whether it affects my company or your company, whether it affects a small plant in some village or town or a big company in a large city, it strikes at the interests of all alike. If the spirit that is shown in this editorial pervaded all those who are opposing us, we would have no trouble; but we do not find this to be the case. Let us join hands in this one thing. If you have a ten thousand dollar plant in some small village, and some one opposes you unjustly there, let us feel that it strikes the two hundred millions of dollars invested in this business in this country, and that we are behind you.

As an electric light man and those who have invested our money in these enterprises, if met by that spirit and with that determination, there is nothing that we can say, and if that spirit and determination is exercised, and the majority believe contrary to what we do as citizens, we must acquiesce in that decision, but we have a right to expect and to demand from our city and from our government absolutely fair treatment. As I have taken occasion before to say in our council, a governmental department, whether municipal, state or national, cannot afford to deal otherwise than strictly in accordance with that beneficent rule of conduct which mankind has named the golden rule. As soon as you lower the governmental standing, you of necessity deeper sink the individual standard of morality.

I trust and believe, from the character of the papers to be read, and from the other matters provided on our programme as well as from the large and interesting attendance, that we will have the most profitable session which we have yet enjoyed, as an association.

We are glad to be able to welcome such a large number of the former presidents of this association. We are glad to recall the history of our previous meetings; we are proud to note the strides with which we have advanced. As the reports will show you, our association itself is in most prosperous condition. Our membership represents—active, associate and honorary—a total of about 250.

I am glad to say that during my official connection with the association I have discovered that the electrical press and by large odds the great percentage of those engaged in furnishing supplies of various kinds to central stations are as jealous as we of the progress of the standing, and the success of the central station men. Our associate members as well as our active members have put one thing in view—to advance to the highest degree of perfection the success of the electric lighting business, and the progress and development of the central stations throughout our country.

Financially we are in admirable condition; our debts all paid and money in our treasury.

Following out the suggestion adopted at the St. Louis convention, we have provided that each sitting shall be followed by an executive session of the association; immediately preceding that is to be a feature, which, if utilized, will prove the most interesting of all parts of our programme—a query place, a place for questions and answers; and I hope full benefit will be taken of this by any and all of our representatives. It is the purpose of this, that any question, no matter how trifling it may be, any central station man wants to ask, he may do so, and some one will answer him. If it is a matter that cannot with propriety be answered in the open session, it will be answered in the executive session, but feel free to ask your question, no matter what it is, or what about. In other conventions, this has proved in my experience to be the most valuable part of all, and I do not see why it can not be here.

The papers that will be read to you are unusually inter-

esting and by most able people. I trust that we will hear not only as to the benefit and advantages, not so great as we hoped they might be, but still important, of the Chicago exposition, but that we will have some report upon the World's Electrical Congress. I am in hopes we shall also be able to hear some words of greeting from representatives of the other kindred associations to ours. I am anxious for the time to come when among the representative gatherings there may be more of a fellowship.

And now it is with a large degree of diffidence I proceed with the duties of my office here. Not bringing to it the technical knowledge possessed by my predecessors, I ask your patience and indulgence and bespeak your friendly forbearance, promising to deal as intelligently as I possibly can with the legal business aspects of electrical light and power, in calling upon those associated with us, who are competent to speak. As to the rest of our business, I shall call your attention to our programme.

I do not want it to be understood that we have not provided for the enjoyment of the representatives; all I meant to say was that we have purposely avoided having anything on an elaborate scale, but we expect you to be able to say when this convention has closed that we have had a most enjoyable time.

A meeting of the National Electric Light association that does not first consider and provide for the pleasure and enjoyment of the ladies, who honor us by their attendance, would immediately be declared by us to be an unconstitutional and revolutionary body, which ought to be patriotically suppressed. A well chosen and admirably equipped committee has therefore made considerable provision for these things, which will be announced to you from time to time, and the only other thing that the chair asks is a prompt attendance at the appointed hours for the sessions of the convention, a careful attention to the proceedings, a lively interest in all that is going on, and we will declare the seventeenth convention as closing upon the most prosperous epoch in our history.

I now declare this convention formally opened.

Invitations.

E. J. Hall, vice-president and general manager of the Long Distance Telephone company, tendered the delegates the use of a long-distance telephone which had been specially put in on the ground floor of the Ebbitt House by the company. President Stephenson of the Metropolitan Railroad company of Washington issued complimentary tickets good on the cars of his company, to those in attendance at the convention. The Cosmos Club of Washington extended the courtesies of its club house to the delegates.

Letters of regret were read from Thomas A. Edison, George Westinghouse, Jr., Nikola Tesla, Charles A. Coffin, Thomas D. Lockwood, Prof. E. L. Nichols of Ithaca, Prof. Henry T. Bovey of Montreal, Gen. Charles L. Knapp of Montreal and Elihu Thomson.

Committee on Legislation.

C. H. Wilmerding, chairman of the committee on legislation said, when called upon for a report:

I regret that this committee has no formal report to make. Since my appointment as chairman of the committee, no important information has reached us in regard to legislation affecting electric light interests. However, there has been a great deal of that sort of legislation threatened, but I am not in a position to speak about it, as different members of the committee, in the different states, have not reported to me as chairman; and I would suggest that if any of the members of the committee are present that they be asked to make some remarks in regard to legislation affecting our interests in their particular states.

Mr. Morrison, Syracuse: I am informed that there is a bill pending before the Legislature of the state of New York authorizing the board of water commissioners of any incorporated village in that state, having a water works system belonging to the village to establish a lighting system within the village for the purpose of supplying light, by means of gas, electricity or other approved system, to the inhabitants of the village.

Mr. Huntley, Buffalo: I do not wish to criticize the excellent chairman of this committe, but during the several administrations that this committee has been in existence it has not done any good, and we have had a report such as we have to-day. I do not think that this committee, as at present constituted, with members in the different states, can accomplish much good. The committee is too cumbersome. There is no action on the part of the committee as a whole; they never get together, and never accomplish anything. I do not want to say that it may be the proper time to discontinue this committee, but I am of the opinion that the committee should be discharged, and a committee of five take the place of this cumbersome organization.

Mr. DeCamp, Philadelphia: I agree with Mr. Huntley on this subject. I have concluded that it is utterly impossible for the committee, as present constituted, to do any efficient work; and something in the line suggested would be. in my judgment, much better than the present.

Mr. Clay, Philadelphia: I would like to offer a resolution to be considered in conjunction with this question, that the officers of the association be authorized to employ a competent person, at a reasonable compensation, whose duty it shall be to compile the legislation of the several states affecting in any manner the electric light interests, with a view that that compilation shall be furnished to every member of this association.

Mr. Insull, Chicago: I think the functions that should be performed by the committee on legislation should be that of preventing legislation detrimental to us, rather than compiling a record of legislation that is past. If we are going to support and aid the $10,000 electric light plant in some small village we should organize to do that in a legitimate way to bring influence to bear upon the different legislatures to prevent the enactment of unjust laws. I think this duty, particularly in an association of this kind, should fall, not on a committee, but on the executive of the association, who should use the full power of the association to prevent, as far as possible, the passage of such laws as are unjust.

Mr. Stetson, New Bedford: Speaking for the old commonwealth of Massachusetts, I can say that we have about three dozen such bills as Mr. Morrison referred to before our Legislature. I have been in attendance at a number of hearings on these bills. Our method is to combine our interests and employ a competent attorney who watches the proceedings all the time. The legislation now in progress has for its oblect to do away with the legislative action of 1891 and 1893, which was the combined wisdom of all the interests that could be brought together at that time that protected to a certain extent the property in the different stations.

On motion the resolution of Mr. Clay was referred to the executive committee.

The president called for the report of the committee on finance. John A. Seely, the chairman, read the report, which showed the affairs of the association to be in satisfactory condition. The report was accepted.

Parent and Central Station Companies.

The next order of business was the report of the committee on "Relation between Manufacturing and Central Station Companies." Frederick Nicholls of Toronto, the chairman, said:

The question of the relation between manufacturing and central station companies is, as we are all aware, an important one, and one that is to be approached with a great deal of consideration. My official report as chairman of the committee is simply that the situation is the same. I think that one of the principal troubles central station men have at present, is, as you and other speakers have already said, the question of municipal ownership. We have to combat the control of municipal lighting first, and as a natural corallary the question of commercial lighting.

The president then introduced Dr. Richard J. Gatling, the inventor of the Gatling gun, who made an interesting address, in which he said:

I think most of the inventions which have been developed in this country have been inspired by our patent system. It has stimulated men to think and invent, and none of us can tell the amount of good that has come to the human race and the people of this country by these valuable inventions. We ride in better coaches than Solomon ever rode in, and we sleep on better beds than kings slept on in the olden time. Americans take out more patents than all the rest of the world put together. We have more undeveloped resources than any other country in the world. We have ten times as much coal and iron as England.

Mr. Hammer, New York: There is a matter which seems to me to be of sufficient importance for the National Electric Light association to take cognizance of it. Under a recent ruling of the Postoffice Department all papers published by colleges, fraternities, scientific or professional societies, are denied admission to the mails as second-class matter, and this compels them to pay from eight to sixteen times as much postage as other papers. The American Institute of Electrical Engineers has appointed a committee to present to the postoffice department the protest of that society against this new measure. There is a bill introduced in Congress known as the Manderson-Huiner bill, which regulates this matter. The civil engineers and mechanical engineers are taking similar action and I might say the cost of mailing the reports of one of these associations will make a difference from $1,500 to $1,800 yearly. I suggest that the National Electric Light association appoint a similar committee to present a protest in this matter as it will undoubtedly affect it as much as the others.

The president accordingly appointed Messrs. Adams, Young and Gwinn a committee to look after this matter.

Afternoon Session.

The president called the meeting to order at 2:30 P. M., and announced the first business of the afternoon session to be the report of the committee on data, which was presented by H. M. Swetland of New York. This report is presented elsewhere together with the discussion that ensued.

The president called for the report of the committee on "Underground Conduits and Conductors." Mr. Francisco, the chairman, said that there seemed to be some misunderstanding in regard to that report. At the time of the Buffalo convention the report of the committee was presented in full, and he supposed the committee was discharged. In December, however, he received notice from the president that he was expected to make a report at this convention. The committee was therefore discharged.

The president announced the next order of business to be the report of the committee on "Rules for Safe Wiring." Copies of the report of the committee were distibuted, but the discussion was postponed until Thursday morning.

W. E. Harrington read a paper on "Faults Incident to the Protection of Lighting and Power Circuits."

Units of Electrical Measure.

The president introduced Prof. T. C. Mendenhall of Washington, who addressed the meeting on the subject of units of electrical measure. He said: "I have no doubt that everybody connected with the electric lighting interests of this country is interested in securing legislation upon this subject. I need not, of course, explain to you the necessity for the use of electrical units; everybody engaged in this business understands that. It is an interesting fact that, notwithstanding that there are many millions of dollars invested in the production of electricity and electrical instruments and devices, and in spite of the fact that in this country we are ahead of the world in electrical matters, we have no legal units of electrical measurement. You are familiar with this matter of electrical units and its history. I will only refer briefly to the fact that an international electrical congress was held in Paris in 1881 and another in 1884. The United States was largely represented at both, and you will remember some of the results of these two meetings. Not a single one of the electrical standards has had a legal recognition in this country; so that if you had a controversy over the amount of the electricity furnished or bought, you will discover that the law in this country, and in every other country in the world, except in England during the last few months, does not recognize any unit of electrical measurement. If a suit should be brought, the court in this respect would be obliged to decide on the mere question of tradition; that is, that it had been the custom to measure the current in amperes. During the sessions of these two congresses it was developed that the people were not ready to accept definitions of electrical units. Expert electricians and scientific men who had come together could not determine what these units ought to be, not being satisfied with their accuracy.

"I need not remind you that in Chicago last August there was held another electrical congress, at which all of the great nations of the world were represented by delegates. There was at that convention a most representative body of men. I think it was universally admitted that it was the best body of men who ever assembled for the purpose of settling the question of units. The result was the adoption of eight units of electrical measures, with most of which you are familiar; they are the ohm, ampere, volt, coulomb, farad, joule, watt and henry. It was pleasing to have this congress add to this splendid galaxy of names of the leading electricians of all times, the name of the most famous and now certainly the best known electrician of America—Joseph Henry. These units were defined by this congress, and adopted in the words of the following resolution, by which it will be seen that they recommend their adoption to the nations of the world:

"Resolved, That the several governments represented by the delegates of this International Congress of Electricians be, and they are hereby recommended to formally adopt legal units of electrical measure.'

"In this country, as far as I know, there is no objection to the adoption of these units, and the Board of Trade in England is using its influence to have them adopted in that country. I know that in Germany efforts are being made by the leading electricians to secure the same, and I think, therefore, we ought not in this country to be slow in adopting the units. You may not be aware of the fact that Congress has the power to make all laws of weights and measures and that it has never exercised that power. Congress never adopted, formally, the pound and yard as standards of weights and measures for the United States. The only measure it has ever adopted is the Troy pound, adopted for the coinage of the United States. I think we should take early action in this matter and endeavor to have these electrical standards adopted here before they are adopted abroad. A bill has already been introduced with this object in view, and the secretary of the treasury has been urged to approve their adoption for use in all departments of the government. I have not the slightest idea there will be any objection to the passage of this bill in Congress; but I presume you know that the very best measure in the world would never pass that body unless its enactment were urged.

"I ought perhaps to say one word more, and that is, the Chamber of Delegates had under long and careful discussion the adoption of a unit of light. I presume you would be more directly interested in that. The necessity for the adoption of a unit of light has long been recognized, but the difficulties in the way are extremely great, as you all know. You have a paper on your programme touching upon this subject, the 'Rating of Arc Lamps.' What is a 2,000 candle power lamp? What does it mean? We were urged to officially define the 2,000 candle power lamp, but we agreed that the time had not yet come for this definition."

An invitation from the Rock Creek Railroad company tendering the use of its lines to the delegates, was accepted with thanks.

The meeting then adjourned to executive session.

Wednesday Morning Session.

The president announced the first order of business to be the report on "The Importance of Complete Metallic Circuits for Electric Railways," which was presented by J. H. Vail.

At this point a handsome basket of flowers was sent up to the president's desk, accompanied by the following communication, which was read by the chairman:

To the Gentlemen Composing the National Electric Light Association:

The ladies accompanying the National Electric Light association as guests of the seventeenth convention of this body—with the same "great dividends *nee* diffidence" expressed by President Armstrong in his opening address—ask your acceptance of this expression of

their appreciation of your courtesy extended to them in a never-to-be-forgotten national drive through the city of Washington.

Tennyson has told us that "Men must work and women must weep." We would modestly suggest that Tennyson had the misfortune not to be acquainted with the ladies of this association, who could have assured him that men will work but never let women weep—at least while guests of the National Electric Light association. Sincerely yours,

The Wives, Sisters and Sweethearts of the National Electric Light Association.

President Armstrong made a graceful response in behalf of the association.

WEDNESDAY AFTERNOON SESSION.

When the convention reassembled on Wednesday afternoon the subject of the development of "Switchboards for Modern Central Stations" was taken up and discussed. The discussion on the Howard arc system was continued. Three minute speeches on the topic, "What Is the Most Economical Size for Arc Dynamos?" were read by Messrs. Huntley, Ayer, Peck and DeCamp. "How to Rate Arc Lamps" was a special order for four o'clock, and in this connection a resolution which had been offered by Mr. Buleigh in relation to the definition of the term "two thousand candle power" was read for the information of the members. Messrs. Ayer, Stetson, DeCamp, Huntley, Beal and Prof. Mendenhall spoke on this subject. The last named gentleman had already addressed the convention on this subject in connection with other topics that came up at the Electrical Congress. The subject was referred to a committee of five composed of Prof. T. C. Mendenhall, Prof. W. A. Anthony, Prof. George Forbes, William J. Hammer and Edward Weston. This committee met later in the day and prepared the following report which was adopted:

Recognizing the difficulty, if not impossibility, of measuring with any degree of accuracy the illuminating power of arc lamps and the great necessity for a more precise definition and statement of the obligation of the producer of electricity for illuminating purposes to the consumer thereof, be it

Resolved, That in the opinion of this convention what is ordinarily known as a 2,000 candle power arc lamp should be rated as one requiring the average four hundred and fifty watts for its maintenance, the measurements being made at the lamp terminals, where no sensible resistance is included in series with the arc. In case such resistance is used it must be excluded in the measurement of the voltage.

Before adjournment it was decided to hold a session on Friday morning, as it was deemed impossible to conclude the business before the convention in the time originally allotted. At the close of the regular order of business there was a general discussion, each member who desired information on any point presenting a problem for the consideration of the meeting.

THURSDAY MORNING SESSION.

On Thursday morning two important papers were read and discussed. A. B. Herrick had an interesting paper on "The Development of Switchboards for Modern Central Stations," and Charles F. Scott read his paper on "Polyphase Transmission." Edward Weston discussed Mr. Herrick's paper at considerable length and at the afternoon session Prof. Forbes took up the subject discussed in Mr. Scott's paper. Both meetings were well attended and much interest was manifested in the discussion.

The following committee to make nominations was appointed: Messrs. DeCamp, Weeks, Seely, Ayer and Carnes.

Mr. DeCamp, chairman of the committee on nominations, presented the nominations for officers for the ensuing year, as follows:

President—M. J. Francisco, Rutland, Vt.
First Vice-president—C. H. Wilmerding, Chicago, Ill.
Second Vice-president—Frederic Nicholls, Toronto, Ont.
Executive Committee—Chas. R. Huntley, Buffalo, N. Y.; A. J. Markel, Hazleton, Pa.; W. W. Carnes, Memphis, Tenn.

The gentlemen whose names were recommended by the committee were unanimously elected.

Resolutions commending Mr. Baker for his efforts in securing transportation facilities, the street railway and telephone companies for courtesies extended, and President Armstrong for the able and pleasant manner in which he discharged the duties of the office, were adopted.

An invitation was presented by the Georgia Electric Light company of Atlanta, Ga., Mutual Light & Power company of Montgomery, Ala., and the Anniston Gas & Light company, Anniston, Ala., for the association to hold its next meeting in the city of Atlanta. The invitation was very cordial and pointed out many advantages which Atlanta possessed as a convention city. The invitation was referred to the executive committee.

FRIDAY'S MEETING.

The extra session on Friday morning was devoted to a discussion of "Arc Lamps on Incandescent Circuits," and "Meters vs. Flat Rates."

The secretary's report showed that about forty new members had been added during the year.

Convention Notes and Personals.

Munson belting was represented by President A. Groetzinger and Col. Shay.

"Insulation" was the topic of Dr. Charles Bowen's conversation during the convention.

"Kerite" permeated the air, but it was a matter of regret that W. R. Brixey did not appear.

The combination Diehl ceiling fan and electrolier placed in the exhibit room told its own story.

J. Holt Gates came down on the New York special and mingled with the crowd at the Ebbitt House.

"Ajax Van Nuis" of New York was heavily weighted in overcoat pockets with his well known switches.

The Goodrich Hard Rubber company of Akron, O., distributed its price list of hard rubber electrical supplies.

The Newton Electric company, manufacturer of general electrical goods, was represented by W. J. Newton himself.

The United States Mineral Wool company of New York showed a sample of its goods neatly arranged upon a card.

L. K. Comstock, Chicago, might have been seen strolling about the rotunda, chatting with old friends or making new ones.

H. A. Cleverly, with his winning Philadelphia smile, posed with his usual grace among the delegates in the convention picture.

P. H. Alexander of Baltimore was one of the late comers at the convention, but he was none the less welcomed by his numerous old friends.

As usual the efficient assistant of Secretary Porter, Miss Billings, was a very reliable bureau of information for the many delegates during the rush of the convention.

The Phoenix Glass company of Pittsburg, Pa., was represented by General Manager A. H. Patterson of New York, who received numerous orders for electric shades, globes etc.

Delegates were reminded of the recent success of the Buckeye Electric company of Cleveland, O., by a number of placards hanging about the hotel and carrying blue lettered "Buckeye."

President William Bracken of the Consolidated Electrical Storage company of New York exhibited a few plates of the pasted battery about which there has been so much talk of late years.

Ernest H. Heinrichs, advertising manager for the Westinghouse company, was of course in attendance, and his geniality and courteous treatment of newspaper men is too widely known to need mentioning.

The McEwen Engine company of Ridgeway, Pa., was well represented by its local agents, F. G. Bolles & Co., who distributed an interesting pamphlet giving a full description of the McEwen engine.

General Manager G. T. Jackson of the Norwich Wire company of New York renewed a number of old acquaintances, and presented convincing facts to many of the delegates regarding this well known wire.

Managers of central stations plants were reminded of the fact that the summer season was approaching through a pamphlet presented by Diehl & Co., giving interesting data regarding electric fans, exhaust disk wheels, etc.

The American Silk Manufacturing company, through President Felix Haac, was busy taking orders for the company's silk waste products, the handling of which has grown from a small business to large proportions.

W. J. Newton, manufacturer of general electrical supplies, of New York, was busily engaged in explaining the interesting points of his new electrical novelties, and returned with a large number of orders to his credit.

Frank C. Tyson, representing the Kartavert Manufacturing company of Wilmington, Del., has been traveling a great deal of late, but he found a little time to spare during which he could add a few more friends to his list.

J. H. Rhotehamel, St. Louis, Mo., represented the Columbia Lamp company at the convention. It was a pleasure to see that contented look which his face has worn since the Columbia company won its great victory.

President W. C. Bryant of the Bryant Electric company of Bridgeport, Conn., was on hand with that ever-present board of Bryant switches, and as usual there was a number of new specialties presented for the inspection of buyers.

The National Chemical Works of Cragin, Ill., a suburb of Chicago, appreciated the advantage of convention advertising, and distributed throughout the Ebbitt House a circular relative to Bonnell's system of scale prevention.

General Manager Hamill of the Brush company and his right-hand man, Mr. Prentice, could be seen mingling with the crowd in the Ebbitt House rotunda. Mr. Prentice, it will be remembered, was in charge of the Brush exhibit at the World's Fair.

A. H. Bauer, chief electrician of Pullman's Palace Car company, was warmly welcomed. As usual, Mr. Bauer's smiling face appeared among the "boys" in the rotunda, and it is rumored that it was not very many minutes before he was mysteriously wafted away in the grasp of some of the numerous gentry, each one of whom is selling, "Old man, the very best plate in the market."

Those interested in slate were enabled to learn something through the literature offered by McNamara Bros. of Fairhaven, Vt. George W. Zelie represents this concern in the New York territory, with offices at 136 Liberty street, New York.

A pleasant little party consisting of G. T. Manson and George A. McKinlock and their families will visit Old Point Comfort, Va., before leaving the vicinity of Washington. The party will remain at Old Point Comfort about a week.

H. A. Hubbell of Bridgeport, Conn., was the assistant of W. C. Bryant, of Bryant switch fame, and added not a little to his success in obtaining a number of orders and extending the courtesies to the many visitors at the Bryant headquarters.

A familiar figure in the Ebbitt House rotunda was that of ex-President Edwin R. Weeks. Mr. Weeks came a long way, but he had many old friends to welcome him and ask after the prosperity of the Kansas City Electric Light company.

It was a matter of regret to many that C. J. Butler, the courteous introducer of the Paranite products, was unable to be present. But it is needless to say that he had an able representative in the person of his eastern representative, Mr. Brigham.

President Elias E. Ries of the Ries Electrical Specialty company was on hand in the interest of his company. Mr. Ries is now working upon a new alternating current motor, which, rumors says, will be a revelation in the line of such machinery.

A handsome circular was distributed by the Dayton Fan & Motor company of Dayton, O., giving information regarding its new ceiling fans, in which are made a number of interesting statements to those who are considering the purchase of this apparatus.

The Backus Manufacturing company of Newark, N. J., presented a neat circular descriptive of its new electric column ceiling fan, which was seen in operation by those attending the convention. The fan is neat in design, and a number of orders were taken.

Manager Charles L. Rodman saw fit to stop over a while in Washington to greet his many acquaintances among the central station men, and remind them again that the Globe Carbon company of Ravenna, O., was still making the same excellent high-grade class of carbons.

The Holtzer-Cabot Electric company of Boston, Mass., through its Washington agents, Royce & Marean, distributed interesting reading matter regarding its new ceiling fans for alternating and direct current circuits, and, it is said, a large number of orders were taken.

The Interior Conduit Insulation company of New York was represented by Romaine Mace, who had three very tastily arranged exhibits of conduit. Mr. Mace also showed a number of new switches which have recently attracted the attention of the electrical fraternity.

The Stirling Boiler company of Chicago, Ill., made many friends on the convention train from New York by the distribution of handsomely bound memorandum books. A testimonial circular entitled "Has a Competitor Ever Advertised You?" was also distributed at the Ebbitt House.

George G. Carter came on from Chicago with the western delegation. Mr. Carter has been wonderfully successful in his new venture in the West. His theory that a good business could be built up by a man who paid attention to a few strictly first-class specialties seems to have proven successful.

The Complete Electric & Construction company of New York, was represented by General Manager John A. Seely, whose time was taken up very much with convention matters, but who gave a share to the many who desired information regarding prospective construction work.

General Sales Agent G. L. Wiley of the Standard Underground Cable company of New York had a spacious parlor which was a general rendezvous during the convention of all those interested in this feature of the trade. A warm welcome was extended to all the company's friends.

Secretary and General Manager A. M. Robertson of the Minneapolis General Electric company of Minneapolis, Minn., greeted many old friends. Mr. Robertson is one of those young men of the West whose energetic work has brought him rapidly to the front. His success is deserved.

It has been a long time since delegates at a convention have had the pleasure of extending a welcome to H. L. Shippey, of the J. A. Roeblings' Sons company, and there was not a little of his time taken up in figuring upon a number of orders which were an evidence of his increasing trade.

The H. W. Johns Manufacturing company, New York, was represented by W. F. Crane, manager of the electrical department, New York, J. W. Perry of the Philadelphia office, and E. B. Hatch of the Johns-Pratt company of Hartford, Conn. This company made no special effort at display but a small and attractive exhibit of a few of its molded mica insulators for various purposes, water-proof sockets, etc., was ably presided over by H. G. Issertel. The business cards

presented by this company were most unique and no doubt have achieved their purpose. It was noteworthy how fondly the numerous owners of the little gilt edged bottles fondled their treasures as if there were "millions" in them.

On Thursday the visitors were photograped in front of Willard Hall. The group presented on page 115 is a reproduction of this photograph. It will be noticed that it contains many old members, but the great preponderance of faces is that of new men.

The Merian & Morgan Paraffine company, Cleveland, O., distributed a cunning little vest pocket pamphlet telling of its various products, viz.: Paraffine pitch, paraffine wax, cold pressed paraffine oil, lubricating, cylinder and machinery oil, paragon axle grease and extra paraffine candles.

Although the American Circular Loom company of Boston was not personally represented at the convention, it was kept in the minds of all through the company's agents, Doubleday, Mitchell & Co. of New York, who had a small but complete exhibit of canvas jacket wire and other insulated conductors.

Dr. J. H. Mason was seen often and interrogated about the hotel by seekers after knowledge regarding the old reliable Simplex wire, and from the serene smile which was seen upon his countenance it was assumed that the trip had some pleasures besides that of attendance upon the convention.

Professor W. A. Anthony of Vineland, N. J., was greeted by his numerous friends and congratulated upon his new venture as consulting electrical engineer. Professor Anthony has recently established an office in Vineland, where his patrons will be given the advantage of his long scientific experience.

The Belknap Motor company of Portland, Me., appeared in the person of Manager Brown. Mr. Brown, it will be remembered, was the gentleman in charge of the Belknap Motor company's exhibit at the world's fair, and it was through him that the company opened its now flourishing business in the West.

The W. S. Hill Electric company of Boston had an unusually handsome exhibit of single, double and three pole throw switches of beautiful workmanship. President W. S. Hill and General Manager G. H. Poor were surrounded by an interested group of listeners while they explained the valuable points of their switches.

T. E. Crossman, the official stenographer of the association, has opened an office at 166 Montague street, Brooklyn, having severed his connection with the Atlantic Avenue Railway company of that city. Mr. Crossman has been for several years stenographer of the American Street Railway and American Water Works associations.

Louis Stirn of the Pull Socket Switch company of New York showed his keen business insight by securing a place for the exhibition of his novel little specialty at the head of the steps up which every member had to go on his way to the exhibit hall. The new pull socket exhibited by Mr. Stirn excited a great deal of curiosity.

President Shainwald of the Standard Paint company of New York was an important addition the last day of the convention among the delegates. He was delayed on account of business, but previous recollections of large orders were too much for him, and from the broad smile on his countenance it was judged that the usual success attended him.

J. A. Van Etten of Little Rock, Ark., was at the convention. Mr. Van Etten is the manager of the Edison Electric Light & Power company, which is one of the best and most thoroughly equipped Edison stations in the Southwest. He is a good friend, too, of the many wandering electric light men who wend their way into his section.

The Abendroth & Root Manufacturing company of New York distributed a very neat pamphlet, descriptive of its water tube boilers, presenting much interesting data together with a striking illustration of the company's installation of boilers as seen during the course of erection in the boiler house of the World's Columbian Exposition.

Louis Nahm, St. Louis, told the story of the advantages of his new Republic lamps and American incandescent lamps. Mr. Nahm, it will be remembered, was one of the St. Louis gentlemen who last year entertained the convention delegates. Both Mr. Nahm and his sister will long be remembered by the electrical fraternity as types of hospitable St. Louisians.

The Crocker-Wheeler Electric company of New York was represented by Dr. S. S. Wheeler and General Sales Agent Lufkin, who were kept exceedingly busy in supplying the demand for the new circular giving the data relative to the compaay's well known machinery. The simplification of the Crocker-Wheeler armature was favorably commented upon.

H. G. Issertel was present with Mrs. Issertel, and divided his time in seeing to the comforts of the ladies and energetically pushing the electrical specialties of the Iona Manufacturing company of Boston, Mass. President Marshall of the Iona company, on account of press of business, was unable to attend, but it is needless to say that Mr. Issertel ably did the honors.

No one was more cordially greeted at the convention than General E. S. Greeley of The E. S. Greeley & Co. of New York. General Greeley was one of the original members of the association, but has for several years been prevented by pressure of business from being present at the meetings. The general was in close attendance at the gatherings and expressed himself as being particularly pleased to find such a number present. General Greeley looks for a revival of business in the near future.

The Automatic Switch company of Baltimore exhibited a new electric heating device, which is a recent invention of Mr. Whittingham, whose work on automatic electric devices is well known throughout the country. The Automatic Switch company feels that it has a bonanza in this new device, and it is said to be a departure in the line of electric heaters.

The Electrical Engineering & Supply company of Syracuse, N. Y., made a most attractive exhibit in the shape of a very handsomly finished switchboard carrying the Electrical Engineering & Supply company's specialties. This board was at the extreme end of the long convention exhibit hall and attracted a great deal of attention. The company was represented by President Goerke and W. J. Morrison.

F. S. Terry of Chicago displayed his usual energy in seeing his many friends at the convention. Mr. Terry is now pushing the business of the Sunbeam Manufacturing company of Chicago. It may be mentioned that the Sunbeam company is making a specialty of small incandescent lamps. The representative of the Sunbeam company is so well known that it may be taken for granted that the lamp was made familiar to all.

If there is any one about whom it could be said that he was never absent from his post, it was S. A. Douglas, general agent of the of the General Incandescant Arc Light company, Mr. Douglas is one of those men whose genial presence and business-like methods make strong impressions upon buyers—in fact, some one has said "it is almost impossible to resist Douglas." Mrs. Douglas assisted her husband in doing the honors.

F. G. Bolles & Co. of Washington saw that the Shawhan-Thresher Electric company of Dayton, O., was fully represented in the Ebbitt House. The Shawhan-Thresher company is now manufacturing a very compact and efficient design of iron-clad motors and generators. These machines are made from half to fifty horse power as motors, and as generators from 16 to 500 lights. A very slow speed is a special feature of this apparatus.

Edmund A. Sarran of Edmund A. Sarran & Co., Cincinnati, O., was on hand. This was Mr. Sarran's first convention, but he was not long a stranger, for his genial and courteous manners made him many friends in the fraternity. Edmund Sarran & Co. deal in electric motors, dynamos, combination and electric fixtures and other supplies. They have a fine establishment in Cincinnati and the concern's progressive policy has brought it rapidly to the front.

"The Okonite Bull's Eye" was a favorite resort for members of the convention. Such hosts as Captain W. L. Candee and G. T. Manson are enough at all times to secure a large attendance when they are present at the convention. This year, possibly more than previous ones, were they sought after by a large number of gentlemen who desired information regarding the well known Okonite wire, and it is said that not a few orders were taken.

Few men at the convention had their hands shaken more heartily with a grip of true friendship than W. J. Hammer of New York, the well known electrical expert. Mr. Hammer has been one of the old stand-bys at almost every convention, and this one, following so closely upon an event which must needs be the happiest and most memorable one in his life, placed him in a position where old friends felt it a pleasant privilege to express their kindliest thoughts.

General Sales Agent S. A. Douglas and E. Lavens, general manager of the General Incandescent Arc Light company of New York, never lost a moment in the good work of making new friends and enlarging upon the Bijou lamps in the hotel and the alternate current lamps of Royce & Mareans in Washington. They also exhibited a fine line of switches.

One of the late comers, but not too late by any means, was George McKinlock of the Central Electric company of Chicago. Mr. McKinlock found many old friends who could fully appreciate the splendid work done by the Central Electric company in its successful work of building up Okonite's magnificent reputation. It is but reasonable to suppose that Mr. McKinlock found time to see a little of the pleasant side of New York life before returning to the West.

Pheonix-like, the New Haven Insulated Wire company of New Haven, Conn., appeared in the person C. I. Hague. Mr. Hague exhibited two very handsome fan motors, which were shown in practical operation. This concern appreciates the advantage of taking time by the forelock and is already pushing for the spring trade in fan motors. This motor has a number of valuable points and is worthy of the inspection of those buying improved ventilating machinery.

The Carpenter Enamel Rheostat company exhibited for the first time an invention of H. Ward Leonard, which promises to be of the greatest importance for rheostats and electrically heated tools and utensils. On account of patents still pending the full details were not made public, but the important results accomplished will be evident when it is stated that any device for the conversion of electricity into heat, such as soldering irons, flat-irons and certain rheostats, can be constructed under the Leonard invention so that the device can, if desired, be operated continuously at a red heat or less temperature without destructive effects. Under the Leonard principle an 18 B. & S. German silver wire has been made to carry a current of 80 amperes instead of 4 amperes, its full current capacity if exposed to the air as usual. The Carpenter company is now ready to fill orders for the Leonard electric soldering iron, which it has just placed on the market.

The Berlin Iron Bridge company of East Berlin, Conn., was represented by Burr K. Field, vice-president, who had an interesting exhibit of the company's new anti-condensation roof lining, which was of unusual interest to the central station men, who saw in this something which would overcome the difficulties which they had met in the water dropping from the interior of the roof upon their apparatus. These materials met universal approval and a large number of orders were taken for them.

Although General Manager Lawler of the Clonbrock Steam Boiler Works of Brooklyn was prevented from giving the expected time to the numerous investigators of the new Climax boiler, he was none the less pleased with having received orders which showed him that his trip to the Capital had not been in vain. The large number of original testimonials and letters which Mr. Lawler had with him was sought after to an extent which indicated that numerous orders would arrive in the near future.

P. H. Hover was present, and those of the buyers among the convention delegates who do not know something of water, acid and alkali proof insulating compounds can be found with great difficulty. Mr. Hover is now energetically pushing the goods manufactured by the Mica Roofing company, New York. Mica electrical insulating compounds are this firm's specialties, and it is needless to say that Mr. Hoover's western experience and wide acquaintance will tend to rapidly increase his trade throughout the West.

The Eureka Tempered Copper company of Northeast Pa., was, of course, represented by John R. Coffman. Mr. Coffman is now one of the best known men in the tempered copper trade, having been in it since its inception. Although Mr. Coffman did considerable good work in the absence of his samples, he was still very much disappointed by their delay in reaching Washington. However, all those who know John Coffman would be willing to predict that several good orders went to Northeast from the Ebbitt House.

John McGhie of the General Electric company was in attendance representing S. Dana Greene of the General Electric company. This was ostensibly Mr. McGhie's mission to the convention, but as Mr. Greene appeared in person it is very reasonable to suppose that his genial and courteous representative was spending his time in gathering from newspaper men and other acquaintances those numberless little "pointers" which show themselves in the handsome and attractive advertisements which issue from under his hands.

The Hammond Cleat company of Boston occupied parlor 39, and F. W. Brigham reminded the fraternity that his company was nothing if not progressive and fully up to the needs of modern electric light appliances. Mr. Brigham, among the many specialties, exhibited a new Hammond plug, and also the company's new trolley guard insulator, adjustable hanger board, waterproof socket, and last but not least the new Hammond fused rosette. A line to the Hammond company will bring catalogue A, which tells its own story.

What would an electric light convention be without genial R. B. Corey, general manager of the Electrical Construction & Supply company, New York? Although Mr. Corey tried to hide himself at one of the prominent hotels near the White House, it is said that after the business hours of the convention a steady stream of interested seekers for knowledge regarding the well known Ward lamp wended its way to his apartments, where he could show hundreds of his lamps from the windows in service at the present time in Washington.

Charles A. Schieren, Jr., with his assistant, E. P. Atkinson, greeted the many friends of the Schieren Belting company in their parlors, where they had numerous samples of their belting, which excited the curiosity of the many delegates present on account of its perfect construction. Since the election of Mr. Schieren as mayor of Brooklyn a large amount of the management of their business has been placed in the hands of C. A. Schieren, Jr., and it is needless to say that the same push and effort will be seen in the workings of this firm.

It was feared that the Partrick & Carter company of Philadelphia was not to be represented at the convention, until Thursday, when General Manager E. W. Wilkins appeared. Although he did not bring a line of his numerous specialties, he was constantly interviewed regarding his ability to fill orders for prompt shipment. The Partrick & Carter company is one of the oldest eastern houses in the business, and not only does it find a market for its goods in the East, but the name is almost as well known in the West, and is synonymous with fair dealing and just treatment.

M. W. Hayden, president and general manager of the Law Battery company, New York, severed his connection last week with that firm, leaving for St. Louis where he is to take charge of the Fidelity Battery Manufacturing Company, a new corporation whose aim will be to supply the trade with whatever may be required in the galvanic cell line. This firm will manufacture its own bushings, covers, jars and zincs. It will

procure carbons from the Fidelity Carbon Manufacturing company of St. Louis, whose productions are so favorably known to the electrical trade. Mr. Hayden is prominently known as one of the pioneer inventors in the battery field. He has a large personal acquaintance.

Treasurer A. D. Newton of the Eddy Electric Manufacturing company of Windsor, Conn., although somewhat late in reaching the convention, was a no less welcome visitor. He did not have an exhibit of apparatus, but it was noticed his time was largely taken up in presenting his claims to a large number of prospective purchasers. Many times during the convention the question was asked if General Sales Agent M. E. Baird would not be in attendance, and regrets were sincere when his many friends were informed that a business engagement in the West would prevent him from attending.

E. A. Scott and M. Pfatischer of the Electro dynamic company of Philadelphia made their headquarters at Willard's. Mr. Scott looked more particularly after the business interests of his company, and needed no introduction to those interested in storage batteries. He has been connected for years with the Electro-dynamic company, and his courteous and kindly treatment of all those with whom he has business makes his company many friends. He was a welcome guest. Mr. Pfatischer is a gentleman well known to the western electrical fraternity through his good work in that section and also in the East.

Wallace R. Seavey, representative of the Long Distance Telephone company, in the Ebbitt House, made many friends for his company by his courteous demeanor and painstaking efforts to see the delegates were given every telephonic convenience during the time the long-distance wires were at their disposal. The Long Distance company, it should be stated, extended the courtesies of its lines all over the country to the convention delegates from the hours of 8 to 9 in the morning and 4 to 7 in the evening. Such hospitality as this speaks well for the kindly feeling among Washingtonians for their brothers in the electrical business.

James I. Ayer, the well known St. Louis electrical engineer, and last year's president of the association, appeared in due season. The sight of Mr. Ayer's face brought back many pleasant recollections of the cordial and lavish manner in which the St. Louisians did the honors last year. This time Mr. Ayer was certainly privileged to enjoy himself, for last year his only pleasure must have been that of the man whose work was well done. It will be a long time before the National Electric Light association forgets the handsome manner in which Mr. Ayer entertained one of the largest gatherings that ever assembled in his hospitable city.

J. S. Crider, secretary of the Washington Carbon company of Pittsburg, Pa., carried a little black sample in his pocket which told a story of American enterprise and progress. Mr. Crider for a long time has been determined that the country should see that the Washington Carbon company could produce strictly first-class carbons in every respect and of such a high grade as to admit of no competition. From the samples exhibited, which were a surprise to many, Mr. Crider proved conclusively that the Washington company knew its business. It is rumored that several large sized orders will testify the confidence of the people in the Washington Carbon company's product.

H. B. Cutter, the stern, blue-blooded Philadelphian, with his right hand man, C. E. Bibber, convinced the majority of the western delegates, as well as many new eastern friends, that the home of the Franklin Institute is developing rapidly into an electrical center. Mr. Cutter's C-S specialties, flush double push switch, flush key switch and flush automatic switch are now so well known in the West as not to have really needed convention exhibition. However, the Cutter Electrical Manufacturing company presented for inspection its cherry board carrying the mounted specialties, and in addition to this there was exhibited a very handsome model of the C. & S. automatic cut-out.

The "Packard family" was all there. There were the little Packards of six candle power, and also the more dignified and portly members of the family of five hundred candle power. W. D. Packard, secretary and treasurer of the Packard Electric company, and B. B. Downs, the Philadelphia Packard representative, were in charge of the family. One of the larger of the "Packards" shed its brilliant rays over the convention exhibit hall, and many were the complimentary remarks passed upon this fine incandescent lamp. The Packard transformer also occupied a prominent place in the exhibit. The Packard Electric company is making a specialty of this transformer and it has already worked its way to the front rank.

The Royal Arc Electric company of New York made its mark with the practical men of the convention by an exhibit of its new arc lamp in the Ebbitt House rotunda. These lamps furnished the light for the rotunda and were operated from the house circuit. An interesting point relative to this new arc light is the company's claim that the life of one pair of 7-16 inch carbons is over 100 hours. The Howard system has been introduced into Hartford, Conn., by the Connecticut Royal Arc company, and the company states that it has been in continuous operation on street and commercial circuits for the last five months. A most valuable claim of the Howard company is that merchants of Hartford, by the adoption of this appurtenance, have been able to save 33 ⅓ per cent. from the established rates made by the Hartford Board of Fire Underwriters. President Howard was the center of an interested group of electric light men, and was kept busy explaining the fine points of this new idea in lighting practice.

The Phillips Insulated Wire company of New York was represented by the president, H. C. Adams, and A. A. Knudson. Mr. Knudson made an interesting exhibit of two coils of Ideal wire, soaking in a tub of water with full current on. The peculiarity of the test was that this same wire had been soaking over two months. The Phillips table, on which the test was made was surrounded by a number of interested spectators. Without going into the details of the test, it may be said that through it were made a great many new friends for Phillips wire.

T. J. Murphy & Co. of New York, manufacturers of slate and marble switchboards, had an interesting exhibit of its material, showing it in use in the various branches of the electrical trade. A novelty was a case for an Edison cut-out, which was new to the trade and presented many features which attracted attention, as did also the new adjusting bolt, for cleaning whereby it could be properly cleaned without removing on a slate or marble board. Visitors were presented with a unique circular gotten up in "ye olden style," which was eagerly sought after as a souvenir.

Great credit is due to C. A. Bragg, A. H. Patterson and J. A. Seely for the delightful manner in which they carried out the social event of the convention, namely, the hop of Thursday evening. The parlors were thrown open, a string orchestra furnished excellent music and dancing was kept up until a late hour. The committee won the hearts of the ladies by presenting each one during the evening with a bouquet of pink roses. There is no question that the bringing of the ladies to the convention added greatly to its success, and it is believed that next year's gathering will be made up more largely by the ladies than has ever been the case before. Although the hop was really an impromptu affair, it was so successful that the committee was deemed worthy of a special vote of thanks.

Treasurer A. H. Pease did the honors for the Hart & Hegeman Manufacturing company of Hartford, Conn. Mr. Pease had quite an interestiug exhibit of Hart switches. These goods, however, must be seen and handled to be fully appreciated. The Hart switch is now offered to the trade as the result of years of work in the perfection of details. All those in the electrical business that know Gerald Hart, who for years was with the Kansas City Electric Light company, as manager and superintendent, will have some idea of the thoroughness with which all Hart & Hegeman work is turned out. As an indication of its rapid progress, it may be said that the firm's increasing business will lead to a removal on March 15th to a much larger factory in Hartford.

The Weston Electrical Instrument company was represented in full force. Edward Weston himself assisted and Prof. Heinrichs and Charles D. Shain never lost a moment in the red parlor. The Weston Instrument company, as is its custom, was fully up with the times and a number of valuable improvements were presented for the inspection of central station men. A very well written pamphlet distributed throughout the Ebbitt House constituted the Weston Instrument company's cordial invitation to its parlor in the Ebbitt House where Prof. Heinrichs was constantly in attendance. This little pamphlet contained also a concise programme of the proceedings of the convention. There is no question but that the Weston Instrument company's exhibit was one of the finest presented at the convention.

Quite a party of well known electrical people came over from Baltimore Thursday morning, including J. Frank Morrison, D. E. Evans, J. M. Orford, Charles Phelps, Charles During and G. M. Holmes. The ladies of the party were Mrs. D. E. Evans and her daughter, Miss M. J. Evans, and Mrs. J. M. Orford. The party remained at the Ebbitt House until Friday evening. It may be mentioned in this connection that Mr. Evans is one of the most experienced electric light men in the country; in fact his work in connection with J. Frank Morrison's enterprises in Baltimore is so well known as to establish his reputation. Mr. Evans is now an independent contractor for railroad and other work with quite an extensive establishment in Baltimore.

The Jewell Belting company of Hartford, Conn., was represented by C. E. Newton and General Sales Agent, C. L. Tolles. These gentlemen were constantly surrounded by a large number of delegates, who were anxious to secure one of their valuable souvenirs. Those present were given choice of two cunning little convention remembrances. One was a little memorandum book, the merit of which was, that when one wanted to detach a leaf for memoranda it was not necessary to pull the book to pieces. It was "just the thing" for convention service. A seal skin card case will also help to advertise the Jewell Belting company in all parts of the country for some time to come. A new catalogue with a number of interesting illustrations of Jewell belts in practical operation was distributed.

A. P. Seymour of Pass & Seymour, Syracuse, N. Y., came down on the convention train from New York. Mr. Seymour's is one of the familiar faces of the convention, having been in the electrical business for years. It will be remembered that his valuable and extensive work in building up the arc and incandescent lighting business in Syracuse, N. Y., first brought him into prominence among practical electric men. This very practical experience has been the secret of Mr. Seymour's remarkable success in the development of many ingenious and thoroughly practical and useful porcelain novelties. P. & S. porcelain specialties are now accepted as standard in many quarters, and as Mr. Seymour has been singularly prolific in his production of novel goods, it is needless to say that the Pass & Seymour exhibit was pretty well investigated by almost every man at all interested in that which is good and new in the trade.

Buffalo had some able representatives in F. P. Little, secretary and general manager, F. H. Williams, treasurer, and J. F. Kester of the F. P. Little Construction & Supply company, The "Mon-arc" lamp stood out among the many other specialties presented for inspection by this company. Mr. Kester was on hand to explain and answer all questions as to lamps. This company's lamp is a "non-sticker," and its simplicity is such as to commend it to the attention of every man who knows what it is to clean and adjust a great number of lamps in a day. McDougall, Lucas & Co. are general Western agents for the "Mon-arc" lamps in the West. Messrs. McDougall, Lucas & Co. are also handling the Climax iron-clad rheostats, and it is safe to say after their convention exhibit of these goods and that made by the Little company the spring business will be found most profitable.

The Mather Electric company was represented at the convention by its vice-president, Thomas C. Perkins. Mr. Perkins made his headquarters with Burr K. Field, vice-president of the Berlin Iron Bridge company, and F. A. Sheffler, general sales agent of the Wilmington Boiler company. Mr. Perkins was particularly fortunate in having a permanent exhibition at the convention in the shape of a six hundred light Mather dynamo which had recently been sold to the Ebbitt House for general lighting purposes. Mr. Burch stated that he would not "take ten times the amount for his dynamo if he could not procure another." There are a number of Mather plants in Washington beside the one in the Ebbitt House. The most notable of these are one at Woodward & Lothrops, the largest dry goods house in Washington, one in A. Lisner's dry goods store of 1,600 lights capacity, another in the Briggs House, 600 lights, another of 500 lights in the Corcoran Hotel and one in the Portland Flats of 400 lights.

The General Electric company, while making no special display of the improved apparatus it has recently perfected and brought out, brought down the first few of the new "Thomson 93" arc lamps for incandescent and railway circuits. These were suspended in front of its Washington agency, opposite headquarters. Examination of the lamp mechanism, which is described elsewhere in this issue, showed great value from the point of view of simplicity. These lamps formed the center of an admiring crowd of arc light station men. In addition, the new arc and railway watt meters were shown. These have only very recently been perfected to meet what had become an urgent necessity. Their practical operation showed a precision and perfection equal to that of the company's well known recording watt meters for incandescent circuits. It is said that business is extremely good with the General Electric company in spite of the hard times. At its Schenectady works its railway department is working full time to turn out the numerous large orders recently received for G. E. 800 motors and multipolar generators. The fitting and appliance department, as well as its wire departments, are also full of busy workers, while the business in lighting apparatus is steadily on the increase. At Lynn the arc lamp and meter departments are more than busy with the newly developed apparatus. The Harrison lamp works report that they are thousands of lamps behind on their orders, even with their extensive facilities. The General Electric company was well represented by the following named gentlemen: S. Dana Greene, A. D. Page and Chas. B. Davis of Boston, F. C. Todd of Washington, Wilson S. Howell, T. Beren and A. B. Herrick, whose able paper on switchboards and switchboard work was one of the attractions of the convention, and one or two others. They were all warmly welcomed by their old friends, the central station men, and from their busy appearance seemed to be laying the foundation for much future business.

Northwestern Elevated Railroad Company.

The Northwestern Elevated Railroad company deposited a check for $100,000 with the Chicago city treasurer on the first of the month as a guaranty that the company will carry out the provisions of the ordinance which was granted it some time ago. The question of the power to be used upon the road is still under consideration by the engineers of the company, and, although nothing definite can be announced at the present time, it is only a question of a short time before the final decision will be given, and there seems to be little doubt that electricity will be the choice. The route has practically been decided upon as far north as North avenue, and as soon as possible the work of construction will be commenced.

The Budapest Electric Car company and the Budapest Horse Car company have presented to the authorities a project for a subterranean electric railway from the city to the Town Wood. They ask a concession of ninety years. The project has been received very favorably by the public, as the line will run along Andrassy avenue, which so far depends on an omnibus service.

Test of Howard System.[1]

C. R. HUNTLEY: It is not my purpose at this time to explain to you the merits or demerits, if there be any, of this appliance, as I see in the room gentlemen who are able to explain the electrical parts of it from a technical standpoint. We knew that the test we were making was one that would appeal to every manager of a central station, as to whether the appliance was a commercial success and whether it could be run as well and as economically and with the same satisfaction to the public as does the open arc that we are using to-day. We assumed absolute control of the circuit on February 4th and put it into the hands of one of our men, giving it the same care and attention —no better, no worse—as we did the other forty-two circuits running from our station. We did, however, patrol the circuit at night from the hour of starting, 5:45 P. M., till 7:10 A. M. in the morning. A representative of the company was with our trimmer. I have with me and will give to you the exact conditions as given to me by the trimmer in his own handwriting, day by day, with the number of lights that were out, how many cylinders were broken and other details, up to the night of the 23d. The circuit in question is in a residence portion of our city and is tolerably free from grounds, or as free as most overhead arc circuits are, going through trees, etc. The test was made originally of fifty arc lights upon a circuit, and the dynamo was a No. 8 Brush machine, of the latest type, which we got into our station last March. I will now give his report:

February 7th—Ferry, corner Grant street, out 1:10 A M, started itself two minutes later.

February 8th—Circuit flashed badly until 12 P. M.; started lamp Elmwood and Summer streets 9:45, by switching off and on; started same lamp 3:00, 4:00 and 5:30 A. M. Carbon burned out 3:10 A. M., Ferry and Richmond. Started Ferry and Grant 1:00, 2:00 and 3:00 A. M., by pulling cable. Stop on clutch too high and lowered arc-spring one turn.

February 9th, 10th, 11th and 12th—Lamps O. K.

February 13th—Put on new cylinders on four lamps.

February 14th—Lamps O. K.

February 15th—Carbons burned out of four lamps.

February 16th—Trimmed circuit, using thirty three cylinders.

February 17th, 18th, 19th and 20th—Lamps all O. K.; renewed fourteen cylinders and trimmed circuit.

February 21st, 22d and 23d—Lamps all O. K., trimmed lamp Plymouth street; cylinder broken.

Referring to the report of February 8th, it should be explained that on that night, believing that we might run more lamps than the fifty lamps in the circuit, we had installed in the station ten lamps with the appliance on them and had five lamps thrown in the circuit, but the circuit flashed so badly from the additional load of the five upon the dynamo that we cut them out and then the circuit went on and we no longer tried to burn more than fifty lights on the circuit.

As to the large number of the renewals of the cylinders on the 16th, it may be said that on that night and the date previous we had a very heavy storm of soft snow—about 18 inches of snow fell. The hood, or storm protector of the lamp was of such a character that much of the snow flew in, and as the water struck the appliance or globe, which is intensely hot, it broke.

The general characteristic of the light is somewhat different to the eye of the public than the ordinary arc lamp. The rays of the light are not as strong, but after the circuit was in good burning order we found that the street was better lighted owing to the horizontal ray of the arc than by the ordinary arc, which gave an intense light underneath but did not diffuse the light into the middle of the block. The burning of the lamp or carbon is such that they form no pencil or crater as they do in the ordinary arc, but burn very slowly and with square ends.

The claim of the maker is that they give a luminous body caused by the carbon monoxide gas; and up to the present time it has worked very well in Buffalo.

MR. SEELY: Was that a sixty-five light machine?

MR. HUNTLEY: Yes, sir; sixty-five Brush No. 8.

MR. SEELY: Do you think that machine could carry more than fifty arc lights at one time?

MR. HUNTLEY: It did not.

MR. DECAMP: With the open arc?

MR. HUNTLEY: Yes; it would.

MR. DECAMP: How many?

MR. HUNTLEY: Ten more.

MR. DECAMP: What is the purpose of that lamp? Is it to save carbon and give a better illumination?

MR. HUNTLEY: Yes; that is the claim as presented to me.

MR. DECAMP: As a matter of fact, what was the saving of carbon; how many times did you trim?

MR. HUNTLEY: We trimmed every four days.

MR. DECAMP: Was the consumption of the carbons uniform?

MR. HUNTLEY: Practically so.

MR. DECAMP: Was it the ordinary standard carbon?

MR. HUNTLEY: No; it was a special carbon, which the gentleman sent on to us and in the manufacture of which there is a secret process. The tubular cylinders, hoods and carbon were furnished by the gentleman who desired the test.

MR. DECAMP: Are the carbons more expensive?

MR. HUNTLEY: The goods were not billed to us at all, and I do not know.

MR. DECAMP: Your own opinion is that the general illumination was better for street lighting?

MR. HUNTLEY: Yes, sir.

MR. DECAMP: What was the opinion of the public?

MR. HUNTLEY: The residents are well satisfied with the illumination; perhaps better than they were with the other circuit.

MR. BURLEIGH: As a matter of fact, was there any saving at all? Did not the expense of renewing the cylinders or envelopes more than off-set the saving of carbons?

MR. HUNTLEY: That we cannot tell because these were given to us. There is no element of cost to us connected with this thing whatever.

MR. RIDGEWAY: What was the length of the circuit?

MR. HUNTLEY: About eleven miles.

MR. MORRISON: How long did the experiment last?

MR. HUNTLEY: They began work about the first of September, and we took the circuit on February 4th and cared for it in the same way as our others.

MR. NICHOLLS: Did you find any saving in the trimming, or was it necessary to have a trimmer go around constantly to find if any of the lamps were out?

MR. HUNTLEY: We found no saving in the trimming, on this particular circuit, because we put one man right there. The claim that is made is that the lamps will burn from 80 to 100 hours and that a trimmer will take care of about 400 lamps.

MR. DECAMP: In what respect does the principle involved in this cylinder differ from that which was involved in what we had eight or ten years ago—the Baxter lamp?

MR. HUNTLEY: I am not at all familiar with the Baxter lamp.

MR. MORRISON: It is a modification of the old Baxter lamp.

MR. MARKS: In looking over the patent situation on this question, I find, as Mr. DeCamp said, that arcs of this type were run years ago. The question which suggests itself is, Why were they not successful? There are numerous reasons. I do not know that I will have sufficient time to go into the causes in detail now, but some of these reasons you will remember were answered at the International Electrical Congress at Chicago last August. I remember that one of the gentlemen who discussed the subject at that time, said: "I tried something of that kind about five years ago in Cleveland, and I found that the bulb blackened in half an hour, and I do not believe it possible to obtain a carbon which will not blacken the cylinder in a few hours." That was one of the numerous causes that led to failure in former years.

I need hardly say, after Mr. Huntley's remarks, that we have obtained a carbon which gives successful results to-day. Another cause of failure was the character of the surrounding chamber. We have a composition which is analogous to glass. In my talk before the International Congress last August I called it glass. Five years ago the substance which was used appeared to be something that was different from glass; the arc having been sprung the chamber exploded frequently. The heat was sufficient to crack the glass, letting out the carbon, monoxide gas and in some instances cause explosion. I would like to answer a question that has been addressed not only to myself, but to several of our experts; that is, Does not your cylinder explode? With our type of lamp, which we have had in the laboratory and in practice for a number of months—I might say in the laboratory for a number of years—we think that we have solved that question. Coming back to the effect of the gases on the cylinder, we find that if we have an arrangement such that the enclosed gas has an opportunity to escape, but the ingress of the air is practically prevented, the pressure on the inside of the cylinder is less than on the outside. If the pressure on the inside of the cylinder were greater than the pressure on the outside, we might expect an explosion; but under the conditions mentioned, I fail to see how it is possible, under any circumstances, in the normal operation of lamps on a commercial circuit, to explode the cylinder. I put myself on record as stating that I have never known a cylinder, with a plug and controlling arrangement for the gases, as used in our type, to explode.

Mr. Huntley has called your attention to the crater. The character of the light, its distribution, amount, etc., are points in which I am interested and to which I have given a great deal of attention. I experimented on an arc at Ithaca last summer in order to determine the effect of coating the cylinder with various ingredients other than carbon, and Dr. Nichols called my attention to the remarkable gain in the distribution of light. He said in the normal arc in the open air we have a maximum of between 40 and 45. In this type of arc the crater extends practically over the entire surface of the carbon. The results of tests, according to my observation, are slightly different from those of Mr. Huntley, regarding the shape of the tip. The crater is not exactly flat, but it extends over the entire surface of the carbon, being slightly hollow. We hope to have an opportunity to show you the carbons which were placed in the lamps now burning in the rotunda of the hotel last Saturday afternoon. They have several nights yet to burn; but we shall take them out and show them to you.

1. Discussion at the c nvention of the National Electric Light association, Washington, D. C., February 28, 1894.

It appears that Japanese electrical engineers are devoting attention to the drawing up of elaborate plans for the utilization of water power and the construction of electric railways. At Uwajima, Ehime-Ken, it is proposed to construct an electric railway between that town and Nakamura, a distance of 50 miles, the Zemba Falls in Kita Uwa-gun to be utilized as the motive power. Another proposed line of electric railway is between Takidani, Kobe and Yuamacho, a distance of 15 miles. In this case it is proposed to utilize the waterfalls in Arino-mura.

Service on the B. & O. Train to the Convention.

It is not often that a railroad company goes out of its way, as did the B. & O. company, to make a brilliant success of a convention special. There is no question but that the Royal Blue Line excelled all records on the trip of March 26th, which will be a memorable one to the large proportion of the class of men who fully appreciate the good things of this life. For months Master of Transportation C. O. Baker, acting in conjunction with Passenger Agent Lyman McCarty, worked incessantly to perfect the railway arrangement so that the Boston, New York and Philadelphia contingent would make its trip to Washington in a train whose equipment and time could not be excelled by any road in the United States. The day of the start from New York was one of those slushy, miserable days which New Yorkers sometimes experience. Early in the morning and the evening before, Boston delegates had been arriving in the metropolis, and when the delegates began to gather at the depot of the Central Railroad of New Jersey, the B. & O. terminus in New York, the scene was a lively one. One by one the boys arrived, some with ladies, some with friends, and all in high spirits. Not only was Passenger Agent McCarty on hand, but Passenger Agent E. G. Tuckerman and General eastern Passenger Agent H. A. Wells deemed the occasion one of sufficient importance for their attendance. Mr. Wells accompanied Mr. McCarty on the trip, but Mr. Tuckerman remained in New York.

The train consisted of five Pullman vestibule, observation, parlor cars, and with the 175 delegates on board, made a very heavy train with which to make the quick run it had been intended to make by the B. & O. people. Had the weather been favorable to admit, one of the quickest runs that had ever been made between New York and Washington would have been recorded. Unfortunately, however, the weather was a serious drawback to making the time for which the train was scheduled. The run was intended to be made in five hours. The run from Newark, Del., to Canton, Baltimore, a distance of sixty-five miles, was made in exactly fifty-nine minutes. The train left Locust Point, Baltimore, at 5:29 P. M., and arrived at Washington at 6:15 P. M., thus making the run in forty-six minutes over the Washington branch. The total time from New York to Washington was four hours and fifty five minutes. Deducting time lost through the yards at Philadelphia, Baltimore and Washington, and fourteen minutes for transfer at Baltimore, would indicate one of the fastest runs between New York and Washington on record.

It is understood that one of the best runs that has ever been made in this country before was between New York and Washington, with a train carrying three cars, in three hours and eighteen minutes' actual running time. It will be seen, therefore, that the B. & O. convention train, with its five heavy Pullmans, which made, it is estimated, an equipment nearly three times as heavy, made the run in a time of which the company may well be proud. Without attempting to describe the furnishing of the interior of this Royal Blue Line special, and to go into details relative to the kind attention of Messrs. McCarty and Baker, which not only made them a host of friends among the delegates, but made the most pleasant impression upon the many ladies on board the train, it may be said that the passengers were treated more like guests than patrons of the road.

At Philadelphia Judge Armstrong and party, together with a goodly number from electrical Philadelphia, boarded the train, and it was there also that Mr. Walvey, general B. & O. agent at Washington, joined the party and aided Mr. McCarty in extending the hospitalities of the road. It may be of interest to mention that those who held watches stated that at one period of the run seven or eight miles were made in five and one-half minutes, and this the railroad men stated was verified by the time from the block stations along the road. So anxious was the B. & O. company that this run should be what it had been promised that an engine was kept following the train from Wilmington to Camden Station, Baltimore, for use in case there was a necessity. Another engine met the train at Canton. In a word it may be said with perfect truth that the B. & O. spared no labor or money to show the electrical fraternity its appreciation of the greatest electrical event of the year.

Affairs of the Nutting Electric Manufacturing Company.

All the property of the Nutting Electric Manufacturing company of Chicago is announced for sale at 10 A. M. on March 8th at the company's factory, 128 South Clinton street, by the trustee of the company, Eugene Clifford. This is the company that manufactures the Nutting arc lamp for constant potential circuits, which received an appreciative award at the World's Fair. Dissensions in the management have prevented an extension of the business, however, and a trust deed in the nature of a chattel mortgage, conveying the property to a trustee, was executed in November. There is ample capital behind the company, and it is expected that after the sale a reorganization will be effected and business resumed.

Chicago Delegation to Washington.

The Chicago delegation arrived in Washington on Monday. The Big Four and Balitimore & Ohio companies offered special facilities and both carried large parties. Many members from other cities in the Northwest joined the party at Chicago and others were taken in at Cincinnati and Indianapolis.

New Thomson Arc Lamp for Incandescent and Railway Circuits.

That arc lamps capable of being satisfactorily operated on the ordinary incandescent or railway circuits are a necessity is evidenced by the extraordinary demand for them which seems to have arisen in a surprisingly short space of time. The General Electric company announces a new arc lamp for incandescent and railway constant

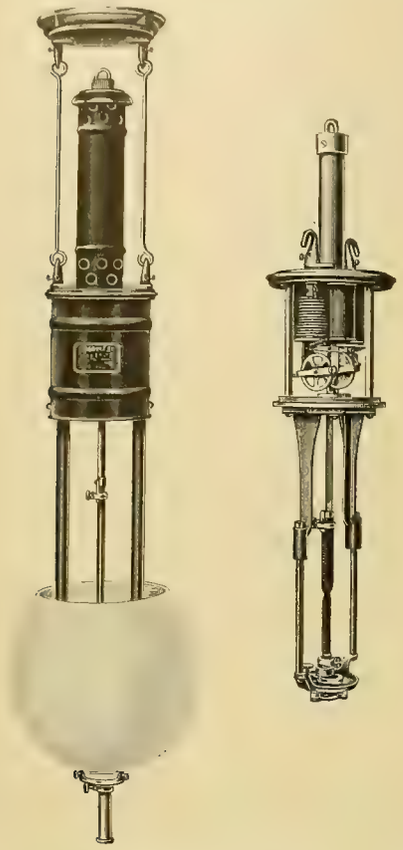
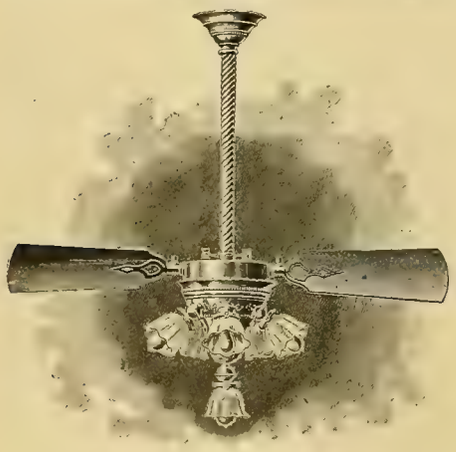


FIG. 1 AND 2. NEW THOMSON ARC LAMP FOR INCANDESCENT AND RAILWAY CIRCUITS.

potential circuits. This lamp is known as the "Thomson 93" arc lamp, and is the adaptation of a principle and construction patented some years ago by Prof. Elihu Thomson. The lamp is constructed of but very few parts; it has no delicate mechanism, and the parts are practically interchangeable in all the lamps. The motion of the carbon rod, either up or down, is entirely free; this allows of a rapid and accurate change of carbon, and the



DIEHL ELECTROLIER FAN.

usual rough handling incident to this process cannot injure the mechanism.

The "Thomson 93" arc lamp is a geared lamp, but has none of the disadvantages of either the clutch or clockwork feed mechanism. The feeding of the lamp is entirely independent of the weight of the carbon, it being equally regular whether with a whole carbon or one partly consumed. The lamp burns a very steady arc, noticeably free from noise, and instantly adjusts itself to any variation of potential. The lamps are adjusted for nine amperes with a 45 volt arc, but can be furnished for any current from four amperes upward on special order.

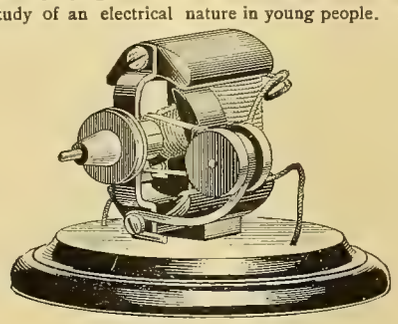
At present four varieties of this lamp have been designed by the General Electric company and are now ready for delivery; that for the alternating circuit is nearly completed. The long lamp for incandescent circuits, shown in Fig. 1, is of plain design and intended for out-of-door circuits to be used two in series on 110 volt lines. The necessary resistance is placed in the chimney and an external rheostat is unnecessary. The total length of this is 49 inches. The short lamp for incandescent circuits, 32 inches long, also of plain design, is intended for indoor use. The other varieties are the long lamp for use on 500 volt railway circuits and the ornamental lamp. The mechanism of the new lamp is shown in Fig. 2.

Diehl Electrolier Fan.

In addition to an extensive line of electric fan devices, Diehl & Co., New York, will offer to the trade during the coming season their new electrolier fan combination. In the accompanying cut this arrangement is shown. Both lights and fan can be operated together or separately as desired. The combination is a pretty one and attracts attention owing to the points of merit which it possesses.

Small Motor Outfit.

The Boston Motor company, Boston, Mass., has placed upon the market a little motor which is shown in the accompanying cut. It is intended to create a desire for study of an electrical nature in young people. It is

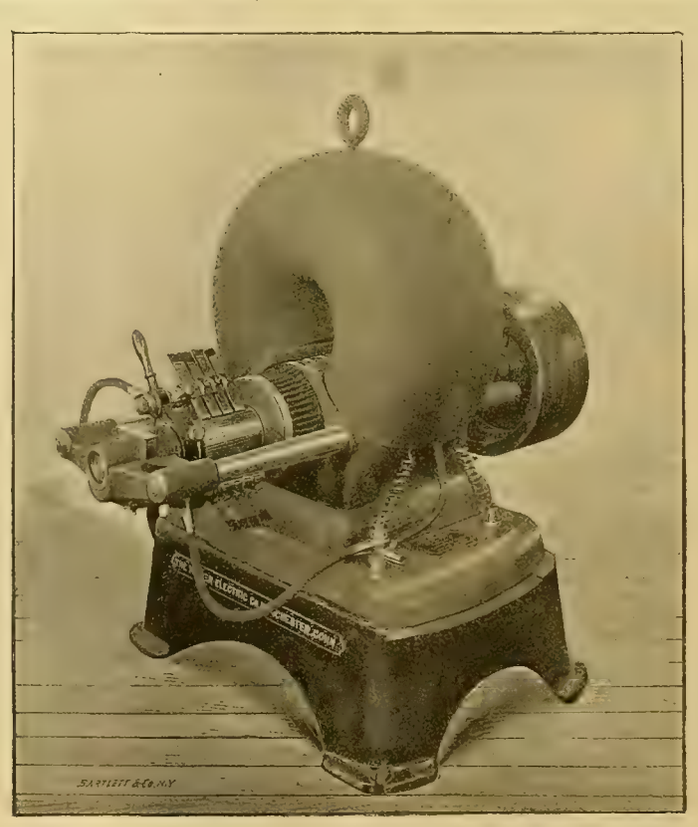


SMALL MOTOR OUTFIT.

designed for running toys, fans, etc., and also for experimental purposes, and is more powerful than other motors of its size. The battery has a base made of a material similar in character to hard rubber, rendering it durable. The battery may be charged for a few minutes or for several hours. The construction of the outfit is complete and of the best materials, with all the parts of a large motor, and includes a battery and chemicals for renewal.

Mather Dynamo.

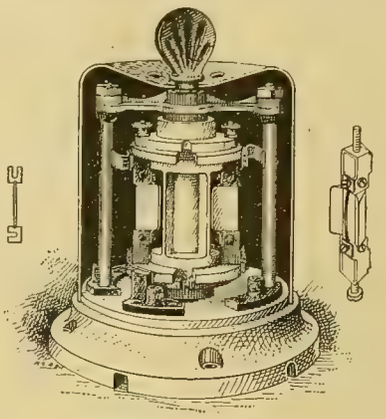
In the accompanying illustration is shown a Mather dynamo rated for about 450 or 500 lights. It is compound wound for 125 volts and runs at a speed of 900 revolutions. As a help to higher efficiency cast-steel fields are used in all these machines. This construction reduces the size and weight of the machines as compared with iron fields. Machines of this type range in size from 50 to 1,200 lights. The larger machines have slotted armatures. A large number of these dynamos are already in use. An extensive installation may be seen in daily use in the new *Herald* building in New York, supplying both light and power.



MATHER DYNAMO.

Multiple Fused Switch.

At present protection against fire, etc., in electric circuits is provided to a great extent by the branch block, which is used in connection with a number of lamps, in a



MULTIPLE FUSED SWITCH.

single room or suite of rooms. Individual rosettes are also employed, thus practically fusing each lamp.

These extra precautions would not need to be carried so far could dependence be placed upon the carrying capacity of the fuses usually placed in the branch blocks.

The multiple fused switch shown in the accompanying cut is a device which possesses considerable merit. It is provided with a porcelain base and a rotative fuse drum of porcelain, which carries removable and interchangeable porcelain fuse holders. These removable fuse holders carry the fuse upon their inner face, removing it from any liability to short-circuit the switch or in any way injure it. The whole apparatus is covered with a lead opal glass cover, which gives a neat and ornamental effect. The apparatus can be used either as single or double pole, as desired. The fuses are of the link type, with copper-tipped ends. As a fuse blows out in this device, a one-eighth turn of the handle breaks the circuit entirely, and a similar turn connects a new fuse. If the short-circuit was but momentary, the normal condition of the line is at once re-established and the burned-out fuse can be removed at leisure and a new one put in its position from a reserve stock. This small fuse holder which is to be re-

moved is entirely out of circuit, so that no inconvenience ensues, and it can be readily replaced. The sliding contacts are of phosphor bronze, and the switch is efficient as such, as well as a fuse-holder.

An objection might be raised that the use of such a device involves the discarding of the branch blocks of ten amperes and carrying the main by an off-set soldered and taped joint to the switch, conveniently located, thereby increasing the fire risk by crossing the negative with the positive lead. What slight increase of hazard is here incurred is immeasurably counterbalanced by the fact that the fuses are of the proper capacity, and an element is utilized which will insure their maintenance of a proper size, because they are convenient to replace.

These switches will be ready for the market about April 1st, the trade being supplied by Melzer & Co., Cleveland. Patents are pending on the device.

Chloride Accumulators in Central Stations.

In view of the large number of electric light stations in this country which are to-day either running a day load at a loss or else furnishing no current at all during the daytime, the importance of demonstrating the advantages of storage battery installations is clearly apparent, since a battery in such stations will not only wipe out the loss, but show a large profit, and enable the lighting company to furnish continuous service. It will be readily understood how much greater will be the economy of a smaller generating plant, operated up to its utmost capacity for the whole twenty-four hours in connection with a storing plant, which, during the light load, will store up the surplus output of the generating plant, and which will, during periods of heavy load, give out this stored energy to assist the generating plant in supplying the increased demand. In the event of a temporary stoppage of the generators, such an auxiliary plant can carry for a time the entire load. In many electric light stations the demand during one-half of the time is so light that it does not pay for operating the plant at all during such period, and so a source of much revenue is entirely lost, which could be secured if a storing plant should be installed. As a regulator of pressure in case of fluctuations in the load the value of a storing plant is inestimable. These fluctuations of load are particularly noticeable in electric railway plants, where the demand is constantly rising and falling, sometimes jumping from almost nothing to the maximum, and *vice versa*, in a few seconds. If placed at suitable points along the line much of the feed-wire system may be done away with, and a great improvement in equality of pressure secured. Such auxiliary plants will act automatically, and require very little attention. An installation of this kind may be arranged to carry the whole load when few cars are running late at night and early in the morning, and for operating an "all night" line, which otherwise would not pay expenses. By the installing of a storage plant many

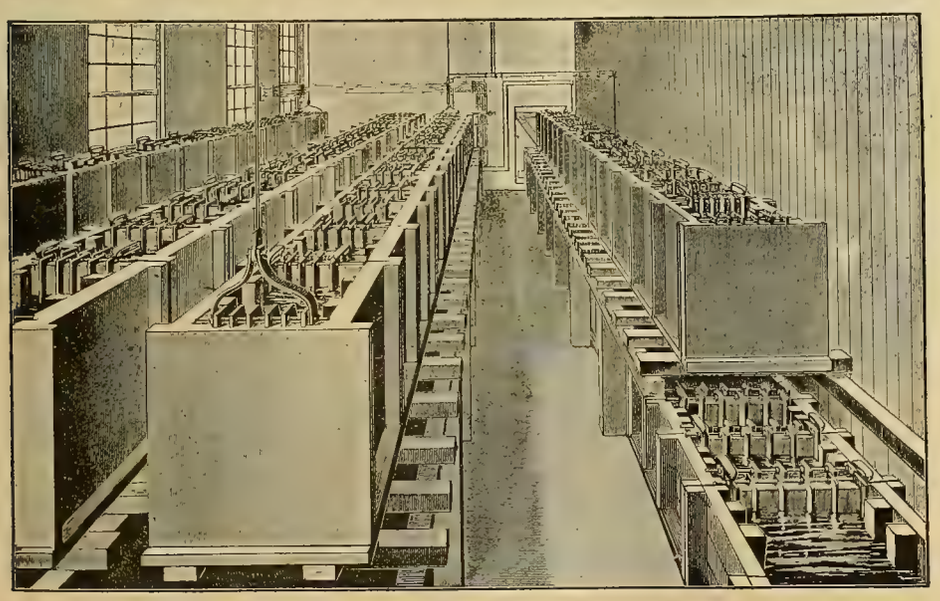


FIG. 1. CHLORIDE ACCUMULATORS IN CENTRAL STATIONS.

natural but small sources of power may be utilized in furnishing light and power—sources which otherwise are not available, because not large enough to supply maximum demands. The force of the tides of small water powers from irrigating ditches, and even of the wind, come under this heading. To all of these applications the Chloride accumulator is particularly adapted because of its large storing capacity and demonstrated durability and efficiency.

A storage battery installation of considerable interest is that installed some time ago by the Electric Storage Battery company at the station of the Germantown Electric Light company of Philadelphia. This battery consists of 120 elements of the Chloride, type G, eleven plates each. They are installed on the three-wire system, and have a normal discharge rate of 100 amperes on each side, and a capacity at this rate of 2,000 ampere hours. The plates are protected by an improved asbestos insulation, and are contained in lead-lined wooden tanks set on glass insulators, and supported on strong supporting stands, painted with acid-proof paint, in four rows of two tiers each, as shown in Fig. 1. The special application of a battery in this instance is for the purpose of carrying the day load of the station for the commercial lighting and power circuit.

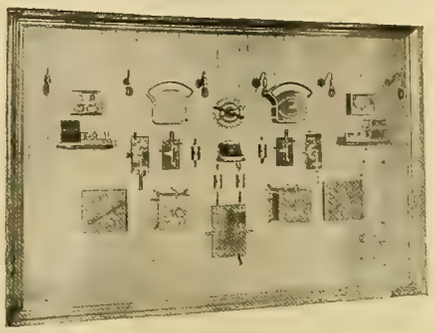


FIG. 2. CHLORIDE ACCUMULATORS IN CENTRAL STATIONS.

The engines are shut down at daylight and the battery carries the whole load until dusk, at which time it is thrown out of circuit, and is put into charge during the early morning hours, when the station load is light, and the cost of charging is practically nothing, as the machinery is more efficient, no extra labor being required during charge, and during discharge the working force of the station is considerably reduced, the battery requiring practically no attention. The potential is maintained in discharge by the cutting in or out of reserve cells, six of which are used on each side. The switchboard is shown in Fig. 2. The Germantown Electric Light company, after over a year's experience with the Chloride battery, claims to have thoroughly demonstrated the advantages claimed for a storage battery for central station purposes.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 3 —As another phase in the rapid transit problem comes an announcement, said to be upon the authority of Russell Sage, that as a practical solution the Manhattan Elevated Railroad company intends to build a second story on its structure, whereon express trains may be run between Harlem and the lower part of the city. Just how soon the work is to be begun is not yet known, but it is said that plans have been completed and that the policy of the company will be to push the work as soon and as rapidly as possible. The second story will be about ten feet above the tracks now in use. The scheme has been under consideration by the Manhattan company for a long time. It has been held back as a trump card to play, and the announcement is only made at this time in order to forestall a rival to the Manhattan, either under or above the ground. Mr. Sage is reported to have said that some other motive power than steam will be used. He does not say just what this motive power is to be, but he makes the statement that it is better than that now in use and that when put in operation on the new structure New York will have a better system of rapid transit than any other city in the world. The announcement, it was said, of these expensive improvements to the system would be a serious setback to other rapid transit plans. It was also pointed out that the Manhattan company might build the double structure on the Sixth and Ninth avenue roads only, leaving the East Side of the city with the present inadequate facilities. Mr. Sage, however, says that, while the addition will be first made on the Sixth and Ninth avenue lines, making a complete double-storied elevated road from the Battery to One Hundred and Fifty-fifth street, the work will be pushed also on the Third avenue line and on all the other elevated structures. He said it would double the present facilities of the elevated roads for carrying passengers, divide the traffic into through and local and relieve the trains of immense pressure now brought upon them during rush hours. Under this plan, said Mr Sage, everybody would have a seat and crowding would be ended. Elevators will be put in to carry passengers up and down. The plans, it is said, have been drawn by one of the most distinguished engineers in the country. The second story can be built without weakening the present structure, but will materially strengthen it. It will have its own pillars leading up from the street through or alongside the present structure. The two structures will then be firmly bolted and joined together, materially strengthening the present elevated road. The distance between the two structures will be ten to fourteen feet, just sufficient to clear the locomotives and cars. The lower structure will be used for the local traffic as at present. On the upper structures express trains will be run by the new motive power. These plans certainly throw a new light upon the subject of rapid transit, and developments in this line will doubtless be carefully watched by promoters of other schemes for relieving the present congested condition of local transportation.

W. F. O.

PERSONAL.

E. Kuhlman of the Hornberger Electric Manufacturing company of Elkhart, Ind., was in Chicago last week.

Steele MacKaye, famous as a dramatist and stage inventor, whose Scenitorium was described in the WESTERN ELECTRICIAN of February 24th, died on Sunday of last week in a railway car on his way to California. Mr. MacKaye was highly esteemed in the theatrical profession, and his funeral, which took place from the Scenitorium on February 27th, was largely attended.

George P. Nichols, who was connected with the Thomson-Houston and General Electric companies for ten years, resigned on the 1st of March, and, with his brother, S. F. Nichols, has opened an office at 936 Monadnock block, Chicago, as an electrical engineer. He has served in almost every capacity with the companies named, both as an engineer and a salesman, and for the last four years he was in charge of the motor department of the Chicago office of the Thomson-Houston company and its successor. S. F. Nichols has been connected with the Boston office of the General Electric company for two years. The new firm will do contracting and construction work, paying especial attention to electrical power transmission, and, with the advantage of George P. Nichols' wide experience can hardly fail of success.

TRADE NEWS.

The F. E. Belden Mica Mining company has sent a novel invitation to the trade to be present at the dedication of its new mill at Rumney, N. H., March 2d, in the shape of a card of mica suitably decorated and inscribed.

Having leased the entire property and plant of Messrs. Waterhouse, Gamble & Co., the Perkins Electric Switch Manufacturing company will continue the manufacture of the Waterhouse, Gamble & Co. arc lamp, maintaining its previous excellent character and quality. The company is ready to fill orders for arc lamps for incandescent circuits.

The E. P. Gleason Manufacturing company, 181-189 Mercer street, New York, is handling about everything pertaining to incandescent lamps. Circulars it is sending to the trade show new styles in street lamps and brackets, deflectors, shields and screens for incandescent lamps, etc. It is also handling colorine and frostine, liquids for coloring incandescent lamps.

The Ohio Brass company, manufacturer of electric railway supplies, Mansfield, O., has issued an interesting and complete illustrated catalogue. The company handles everything in the way of electric street railway materials and supplies, and all the devices are thoroughly tested for electrical and mechanical defects before being sent out. With abundant facilities for the manufacture of special devices, the company solicits correspondence with those having articles which they wish to place upon the market.

The catalogue just issued gives a good idea of the field that is covered by this firm, embracing as it does almost every application of apparatus in modern street railway practice.

The Metropolitan Electric company, Chicago, expects to have its four hundred page catalogue ready for distribution soon and wants everyone to have a copy. Applications for this book will receive due attention. P. & B. tape, one of the products of the Standard Paint company, for whom the Metropolitan Electric company is the general western agent, is finding many friends in electric railway construction, as the orders of last week, as reported by the company, will testify.

The Central Electric company is in receipt of the following communication from one of the leading electric light companies in the country: "We are obliged to you for your calendar for 1894. We were on the point of writing for one, because it was the most sensible and complete one we had last year, and we hoped you were printing one of the same style for this year." The Central company's calendar is a complete electrical calendar, and anyone in the trade who has not received one should request the Central Electric company to forward one at once.

The Electric Storage Battery company of Philadelphia has issued a challenge to the manufacturers of storage batteries in this country for the comparison of the Chloride accumulator with any cell of their manufacture. The Electric Storage Battery company proposes to place in the hands of Houston & Kennelly, Betz building, Philadelphia, a Chloride accumulator of any given weight, to be tested by them against batteries of like weight, and agrees to forfeit $500 in each case where the Chloride cell does not exceed in efficiency, capacity and durability the other batteries by 50 per cent. The contesting companies will be obliged to deposit $500, which shall be paid to the Electric Storage Battery company in case the Chloride battery exceeds in the three particulars mentioned, the contesting batteries by 50 per cent.

BUSINESS.

The Chicago offices of the General Electric company were removed last week to the new quarters on the tenth floor of the Monadnock building.

Charles Wirt has purchased from the Ansonia Electric company the Wirt laboratory together with the stock of Wirt indicators, and he will in future carry on that business at 56 Fifth avenue, Chicago.

E. P. Roberts & Co., Cleveland, O., have received the contract for a dynamo, wiring and fixtures for the New Pilgrim church of Cleveland. About 750 lights will be used. An engine of 65 horse power will drive the dynamo and a fan for the indirect heating system and for ventilation.

The latest specialties which the Bryant Electric company has placed upon the market consist of a 500 volt single pole cut-out and the different sized Sawyer-Man main and branch blocks. These cut-outs have received the approval of the underwriters. Thomas G. Grier and Edward R. Grier, the western representatives of this company, are located in the Monadnock building, Chicago.

The Great Western Manufacturing company, Chicago, announces that it is meeting all competition prices on Howard incandescent lamps, and that it keeps a full line of lamps in stock at Chicago to meet orders for barrel lots. The company is also well supplied with Clark rubber covered wires and cables, electric combination fixtures and the Bain electrical apparatus, and it is doing a good general electrical supply business.

Henry G. Issertel, E. E., formerly of the A. B C. company of New York, has taken a new departure and is now known as an electrical broker—a field hitherto unexploited by the electrical fraternity. In this capacity Mr. Issertal proposes to keep in touch with the progress of the times and well informed as to prices, and to place the orders of his customers with manufacturers of electrical specialties having the best articles at the lowest prices.

The Electric Appliance company, Chicago, has been quietly building up a nice trade on the Acme tape, a specialty which it first placed on the market over two years ago, and which has stood the test of time and made many friends. O. K. weatherproof line wire is rapidly gaining ground as a leading weatherproof wire, and the Electric Appliance company states that each month shows a large increase in the sales of this leading specialty.

The C. & C. Electric company announces the removal of its general office to 143 Liberty street, New York, and of the works to Garwood, N. J., on the Central Railroad of New Jersey. The company is prepared to furnish multipolar dynamos, direct-driven or belted, in sizes up to 250 horse power, bipolar dynamos to 100 horse power, automatic or hand-controlled electric motors, complete plants for power transmission, isolated lighting plants and central station apparatus.

Much attention has been attracted by the new storage battery manufactured by the Day-Moberg Electric company, 54 Pearl street, Boston. It is made in such a manner as to take extra precautions against short-circuiting, and buckling is pronounced impossible by the company. The Jupiter battery is said to be constructed upon entirely new lines and avoids the use of plates altogether. The weight of the cell is very light, and it is claimed that it will not sulphate from over charging, and that it loses very little current on open circuit. The battery is the invention of F. E. Moberg, who has had a long practical experience in electrical circles in Sweden and the United States. The small motors made by the Day-Moberg company are intended for any voltage, are compact in shape, are made with much care, and a careful inspection is given them before leaving the factory.

The Dow Adjustable Light company, Braintree, Mass., has placed upon the market a novelty in the shape of the Dow adjusting ball for electric lights. This article comprises a reliable mechanism for instantly raising or lowering an electric light and especially adapted for stores, offices, hotels, libraries or any place where a movable light is required. The company has also been pushing Dow's patent fusible connection, which is used for attaching a drop light to a chandelier or electrolier and is safe and especially adapted for the purpose.

Frank Overbagh, manager of the Chicago General Fixture company, 169 Adams street, Chicago, and well known in electrical circles through his connection with the Edison General and General Electric companies, is putting on the market a large and complete assortment of electric light and combination fixtures, as well as a full line of general electrical supplies. The company has just issued a new catalogue, number 18B, which contains an excellent line of specialties, among them several new ones which will doubtless meet with favor among users.

The Central Electric company, Chicago, has placed its house goods and retail departments in charge of W. R. Pinckard, who has had several years' experience in those lines, and is personally well-known to the electrical fraternity. This concern reports that its business in these two departments is increasing so rapidly that it finds it necessary to increase its facilities. One of the most important specialties in the house goods department is the line of Edison-Lelande batteries, physicians' supplies, battery fan motor outfits, etc., manufactured by the Edison Manufacturing company, and for which the Central Electric company has special selling arrangements.

The Westinghouse Electric & Manufacturing company opened a San Francisco agency about March 1st, with an office in the Mills building and a full line of the company's standard supplies will be carried to satisfy immediate wants. Those interested in long-distance power transmission can there obtain information and estimates from the company's engineers. Each transmission proposition is an engineering problem in itself, and the representatives will take pleasure in furnishing information on the subject to all enquirers. The excellence of the Westinghouse railway, lighting, mining and other apparatus merits the consideration of contemplating purchasers. The San Francisco representative will be H. A. Russell, assisted by R. B Elder, both of whom are already well known in the electrical business on the Pacific Coast.

The Hornberger Electric Manufacturing company, Elkhart, Ind., is in receipt of a letter from the Helios Electric company testifying to the merits of the Elkhart transformer manufactured by the former company. The Helios company says: "We beg to inform you that we have very carefully tested your new transformer, and the result of our tests convinces us that your transformer is equal in every way to the guarantees you have made us. We find our arc and incandescent lamps can be operated on it at the same time without change in the electromotive force, and there is apparently no change. We also find that it works satisfactorily either with one arc lamp or full load incandescent lamps, or with one incandescent lamp with full load of arc lamps. We believe this transformer solves the problem of maintaining two different potentials from the same transformer; in other words, running arc and incandescent lights from one transformer."

The publication of the amounts of the several bids opened by the St. Louis water commissioners for 1,800 horse power of boilers for the new pumping station has caused considerable comment in consequence of the wide difference between the bid of the lowest, that of the National Water Tube Boiler company of New Brunswick, N. J., and the others. That the National company should have made its bid nearly 20 per cent. below the lowest of its competitors, and over 40 per cent. below that of the highest, is surprising. The explanation is apparent, however, when the fact is shown that the specifications of the commissioners provided for a premium of $250 on each of the six boilers for every one per cent. of efficiency actually reached by the boilers above a given per cent., with the same amount of forfeit for each one per cent. below. The contract was awarded to the National Water Tube Boiler company after considerable competition.

In spite of the general depression, the Page Belting company of Concord, N. H., reports that it is unusually busy for this season of the year, having in hand many large orders. At the present time it is making three wide belts for the Suburban Electric company, Elizabeth, N. J.; a 54-inch double belt for the Union Railway company, New York, and for a large New England manufacturing concern, a wide, three-ply belt of construction similar to that of the large tandem belts which the company exhibited at the World's Fair running on the Allis engine. All these belts are of the Crown brand, for which the Page Belting company received the highest award at the Columbian Exposition. This company was enterprising enough to be the first to publish a copy of this award and a reproduction of the Columbian medal of award as designed by St. Gaudens, which has created such a stir. Beside these orders the company has recently shipped to Japan a very large order of single belting, the third received from that country since the first of the month.

Warren Webster & Co., with works at Camden, N. J., and Chicago office at No. 2 Canal street, report among the orders received for their Webster vacuum feed water heaters and purifiers, one from Pullman's Palace Car company, Pullman, Ill., for three, aggregating over 5,000 horse power; also for an order for the Williams vacuum system of steam heating, so as to utilize the waste exhaust steam, without back pressure upon engines, for heating purposes. Former orders received from this company amounted to 2,700 horse power, and the machinery was installed in its plant at Pullman, Ill., during the last four years. Warren Webster & Co. claim to have the best methods for correcting feed water for boilers and for utilizing exhaust steam for heating purposes, without back pressure upon engines, giving the best results upon all points of economy. They built their present new works at Camden, N. J., last year, and are now commencing an extension of 60 by 65 feet in their wrought iron department.

ELECTRICAL PATENTS.

Issued February 27, 1894.

515,321. Insulating Thimble. Isaac A. Brown, Toledo, O.

515,333. Method of Peroxidizing Lead. William W. Griscom, Haverford, Pa.

The process consists in subjecting the anode to an electric current while immersed in an electrolyte containing nitric and sulphuric acid in a ratio less than one to three.

515,342. Electric Arc Lamp. Georg Kirkegaard, Brooklyn, N. Y.

515,366. Electrical Railway Signal. Henry V. Rily and Charles Selden, Baltimore, Md.

515,374. Electrical Controller. Elmer A. Sperry, Cleveland, O.

The controller is supported by a hinge at its base upon the dasher of the car. The controller may be tipped forward, whereby access is readily had to the connections on the rear of the box.

515,386. Dynamo electric Machine. Jonas Wenström, Örebro, Sweden.

An armature is attached to one of the two poles of a dynamo, said armature having a continous uninterrupted surface adjacent to the air gap, a keeper of solid magnetic material being provided which revolves in the air gap between the armature and the other pole.

515,397. Electric Gas Lighter. John O. Dahlgreen, Boston, Mass.

515,401. Electric Heater. Austin S. Hatch, Windsor, Ont.

515,432. Primary Battery. Charles J. Hubbell, Boston, Mass.

515,448. Fixing Electric Conducting Wires to Insulators Supporting Same. Rudolf Schomburg, Berlin, Germany.

515,465. Electrical Glow Lamp. Herbert Cottrell, Newark, N. J.

A conductive coating is put upon a portion of the bulbous surface, and a central electrode within the bulb of spherical or conical form is provided, between which and the conductive coating an intense electro-magnetic discharge may be produced.

515,467. Armature for Electric Machines. Waldemar Fritsche, Berlin, Germany.

515,473. Regulator for Continuous Current Arc Light Circuits. Daniel Higham, Boston, Mass.

An electro-magnetic device or means responding to wave variations of current is employed in combination with a second device responding slowly to variations of mean intensity of current and acting to regulate the main or generated current.

515,478. Bond for Electric Railways. Julius Meyer, New York, N. Y.

515,484. Socket for Incandescent Lamps. Louis Stirn, New York, N. Y.

515,485. Lamp Socket. Louis Stirn, New York, N. Y.

515,488. Electric Motor. Constant Doriot, Philadelphia, Pa.

515,502. Secondary Battery. Leslie B. Rowley, Ashland, Wis.

515,503. Auxiliary Fire Alarm Telegraph System. Joseph Sachs, New York, N. Y.

515,531. Switch and Circuit for Telephone Exchanges. Joseph J. O'Connell, Chicago, Ill.

515,572. Conduit Electric Railway. Joseph A. Cassidy and William A. Butler, New York, N. Y.

515,589. Signaling Apparatus. Oscar D. Kleinsteuber and Monroe A. Kleinsteuber, Milwaukee, Wis.

515,606. Incandescent Lamp Socket. Rufus C. Nourse, South Framingham, Mass.

515,613. Current Collector for Dynamos. Charles R. Roberts, Addison, Pa.

515,638. Electric Alarm System for Railway Crossings. Adoniram J. Wilson, Port Chester, N. Y.

515,648. Automatic Electric Railway Signal System. Charles P. Breese, New York, N. Y.

515,652. Apparatus for Electrically Heating or Working Metals. Charles L. Coffin, Detroit, Mich.

Electrodes for the passage of current and an arc disturber with mechanism for changing its relation to the electrodes constitute the essential features of the invention.

515,654. Electric Railway. Benjamin F. Comstock, Decatur, Ill.

515,665. Signaling Apparatus. James W. English, New York, N. Y.

515,693. Electric Heater. Samuel E. Nutting, Chicago, Ill.

515,709. Telegraphic Instructor. Thomas J. Houck and Harrison M. Browning, Baltimore, Md.

515,716. Insulated Pipe Coupling. George Peeples Philadelphia, Pa.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, MARCH 17, 1894. No. 11

A Diversified Central Station Plant.

Perhaps there is no central station plant in the West that typifies more accurately the growth of the electric lighting industry than that of the National Electric Construction company of Chicago. Not five years ago the plant was opened for business, the installation comprising two arc dynamos, a Brush machine and an Excelsior dynamo of small capacity. These two machines were located in a basement under the University Club building on La Salle street, in a room 40 by 50 feet. Gradually the plant grew and additions were made until it has reached the proportions shown in the accompanying illustrations. A new 40 or 50 light arc machine is to be installed next week. It has been the policy of the company to use small units, and as no particular style of apparatus has been given the preference, the result has been quite a varied assortment of electric lighting apparatus; and it is for this reason that the plant is of interest, as the business of the company consists in lighting the large office buildings in the immediate vicinity of Madison and Dearborn streets, and no serious problems of distribution have been encountered. The capacity of the plant, including the new arc machine, will be about 140 2,000 candle power arc lights and 4,350 incandescent lamps.

At the present time the load is distributed upon 10 dynamos, eight of which are belt driven from a line of shafting 43 feet in length, coupled to two Russell, four valve simple engines, one 15 by 20 inch, of 210 horse power capacity at 212 revolutions, and the other 14 by 20 inch of 180 horse power capacity at the same speed. These engines may be run as twin engines, or independently, as the conditions of the load requires. Two dynamos are belt driven by a Ball & Wood simple, 13 by 12 inch engine of 110 horse power capacity, at 315 revolutions. The disposition of these 10 dynamos, three engines, a line of shafting provided with three 150 horse power Hill cut-off clutches (each pulley having a 80 horse power Webster clutch) elevator pumps, two switchboards and the usual accessories to a central station plant, into a span 40 by 50 feet, has been accomplished in an ingenious manner, when the obstacles in the way, such as a lack of masonry foundation, and the presence of immense supporting pillars are considered.

Fig. 1. Fig. 2. Fig. 3.

A DIVERSIFIED CENTRAL STATION PLANT.

From the illustrations grouped upon this page may be gathered some idea of the arrangement of the plant, Figs. 1 and 3 showing some of the dynamos driven by the shafting and Fig. 2 illustrating a portion of the switchboard and several of the machines. Prominent in Fig. 3 is a 50 kilowatt, 800 light Rockford dynamo, belted to one of four 78 inch pulleys with 12 inch faces. Between this machine and the shafting is an Akron 30 kilowatt 475 light machine driven tandem in connection with a Schuyler 25-lighter, by a 74 by 12 inch pulley and a Brush 35 light arc dynamo belt being driven through one of the brick supporting pillars from the line of shafting. To the right of the Rockford dynamo, and not shown in the illustration, is a Thomson-Houston motor type, 50 kilowatts, 800 light incandescent machine belted to a 78 by 16 inch pulley. The principal figure in Fig. 1 is one of two 40 kilowatt Thomson-Houston motor type, 650 lighters, driven by a 16-inch face pulley. The machine of this type not shown is driven tandem in connection with a Ball 30 light arc dynamo, set in a steel frame and having two armatures on its shaft, wound for 1,500 volts. The Ball dynamo is shown in Fig. 2, as well as a portion of the incandescent switchboard and the Ball & Wood engine, which drives an Akron 30 kilowatt, 475 light dynamo and a Thomson-Houston 30 kilowatt, 500 light machine of the "squirrel cage" type.

Combustion is obtained in the boiler rooms by both natural gas and coal. The battery of boilers under which natural gas is used is shown in Fig. 4. It consists of three 100 horse power Russell boilers provided with smoke consumers. The gas is piped to the boiler room in 8 inch mains. Two six inch pipes may be seen in front of the boilers in Fig. 4. Six two inch pipes lead to the burners. The breech-

ing from the boilers leads to a brick stack, 30 inches by 6 feet, and 178 feet high. The other boilers are fired with coal, and are of about 100 horse power capacity each, 60 inches by 16 feet, with 48 four-inch tubes. The boiler-room is so arranged that it is very little or no trouble to make an evaporation test for either the electric plant or the pumping machinery necessary for the operation of the elevators in the building, as the piping is so arranged that the batteries of boilers may be run separately or together. Each battery has its own water meter and thermometer on the feed water pipes, and all coal that is used is first carefully weighed, so that a test may be made as to the relative economy in the use of coal and natural gas.

Scattered about the plant are eight steam pumps, the largest of which is a 16 and 25 by 5½ by 15 inch Worthington duplex machine. Current is furnished a C & C motor of 50 horse power capacity, wound for 220 volts geared to a Crane triple power pump with water plungers four by nine inches, single acting, which is used as a reserve and furnishes water at 800 pounds pressure for the elevators in the adjacent Boyce building, when the compound steam pumps intended for that purpose are not in use.

The main switchboard, a portion of which is shown in Fig. 2, is 8 by 16 feet and controls 14 circuits. It contains seven ammeters and rheostats, two voltmeters, the

FIG. 4. A DIVERSIFIED CENTRAL STATION PLANT.

usual overthrow switches and a voltmeter switch. The arc board, which is of slate, is 5 feet by 4 feet 4 inches, and is provided with plug switches for the four circuits and three ammeters.

Ventilation has been provided for by a 40-inch fan making 1,000 revolutions, driven by an eight and a half horse power moter and a 36 inch fan similarly driven. The plant is in charge of E. E. Schemerhorn, superintendent, and W. L. Elliott, chief engineer, to whose care much of its success is due.

New Form of Rail Bond.

Among the recent electrical inventions is the new form of bond-wire for electric railways, patented by Albert Hoffmann and Joseph Brogan of Milwaukee, Wis., which is illustrated by the accompanying cuts. Fig. 1 is a perspective view, with the slotted washer detached, while Fig. 2 shows a section through the adjacent ends of a pair of rails and illustrates the manner of application. A pair of washers *C C* is arranged to be engaged with the opposite bent ends of the wire, being each provided with a concentric aperture *C'* for the admission of the end of the wire, and in one of its faces, being provided with a radial groove or depression *D*, Fig. 1. The washers *C C* are slipped into position upon the ends of the wires, the angular ends thereof passing through the concentric apertures *C' C'* in the washers, and the wire adjacent to the angle or bend therein, entering the radial groove or depression *D* in the washer *C*, so as to lie practically flush with the outer face of said washer. When the washers have been adjusted in position they may be secured to the wire by solder or otherwise. With this form of construction, the ends *B B* of the bond wire are inserted in the apertures in the webs *E E* of the rails, the washers *C C* being driven into firm contact with the faces of the webs of said rails, and the ends of the wire then headed down upon the opposite sides of the webs of the rails, as shown at *b b*, in Fig. 2. The faces of the washers which rest against the sides of the webs of the rails afford a broad contact or bearing surface, and the tighter the ends of the wire are driven into the apertures and riveted or headed down upon the opposite side, the more perfect will become the contacts. Inasmuch as the wires rest against the outside of the washers, there is no liability of the contact between the ends of the wires, and of the washers becoming broken or imperfect by reason of the hammering or pounding upon them in riveting them in place.

Notes of a Trip to the United States and to Chicago, 1893.

By W. H. Preece.

Part IV.

There are three power houses in Boston, the other two developing 2,000 horse power each, so that there is 10,000 horse power used in Boston for working the street railway system.

The line is no longer run by contractors. It is entirely in the hands of the railway company itself. They have magnificent workshops and a very fine staff. Their chief engineer, Mr. Hirt, was extremely attentive and communicative. He supplied me with capital drawings of the works and general arrangements.

The use of belting was again surprising; but I was told that a very large railway system at Brooklyn was going to be worked by direct-driven power, so as to obtain an authoritative and convincing trial of the relative merits of the two systems. I did not learn the type of engine to be fixed at Brooklyn, and I was unable to go there to find out.

The track is light, as I have previously mentioned, but they are welding together the fish-plates and the rails so as to obtain an electrically perfect return circuit. I saw the car and apparatus used for this welding process, but I could not see it in operation, for one essential part of the plant was being repaired.

I saw the electric snow plows used to keep the tracks clear in wintry weather.

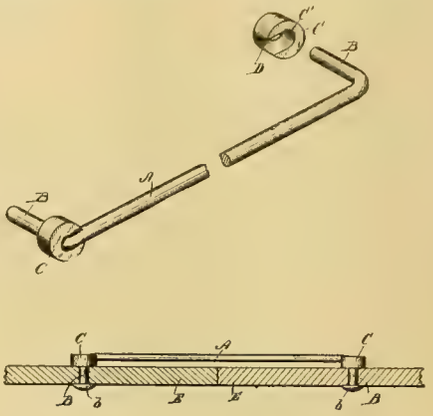
The system of railway working in Boston has given such satisfaction to the public that the traffic returns have improved 30 per cent. owing to the change from horses to electricity. The service is so much quicker, cleaner and better performed. A railway car in full service is said to run an average distance of 250 miles a day, and its mean speed is 15 miles per hour.

There is an important question under discussion in the United States of America—whether it is better to pursue the present practice of using two motors upon the cars, one on each wheel axle, or to use only one motor connected electrically and flexibly with the wheels by beveled gearing. This is the plan advocated and practically carried out by Mr. Sperry. The weight is thus placed in the middle. The horizontal pull is said to be greater. The starting torque is smaller. It is more easily controlled. There is no slip, and the velocity of all parts is uniform. It will climb a stiffer grade. One 35 horse power motor replaces two 30 horse power single reduction Thomson-Houston or Westinghouse motors with economy of energy, The system is working in Pittsburg, where it was adopted after a very severe trial with a Westinghouse car, and it is about to be used on Twenty-second street in Chicago. It has this disadvantage—that if the motor fail there is not a second one available to take the car home. The problem is an interesting one, and its solution will be watched with great interest, for it has an important bearing on the economies of our English roads.

The feeling is pretty prevalent in the States that the conductors must eventually go underground. Experiments in this direction are being made in several directions, notably in Washington and Chicago. The trolley with its guard wires is really an abomination, and the disturbances created by insufficient return accommodation are annoying the telegraph and telephone interests, and alarming the gas and water companies. The future working must be metallic circuits and underground conduits. It is so done in Budapest, and it has been partially done in Blackpool and in Rome. Other experiments are contemplated in England. No one can doubt that the future of electric railways is very bright. The South London railway and the Mersey Dock elevated railways are examples of great successes in England, but it is in the States, where this form of locomotion has become a necessity, that we are sure to see a speedy and practical solution of the problem.

CONCLUSION.

I have by no means exhausted the many notes made during my trip, but I have said enough. Interviewing is a feature of American journalism that, thank goodness, has not taken root here. I was surprised to read of interviews with myself, extending to two or three columns, that resulted from the passage of a few compliments; but I was more surprised to find that statements supposed to have been made by me to an interviewer were taken *au sérieux*. One irate functionary compared an official statement of a past postmaster-general with a mythical statement made by me, and triumphantly pointed out such a glaring contradiction as a complete refutation of my fallacies. I even read that I had stated that we electricians in England had nothing to learn from America. I have no recollection of ever having made any remark which could by any shorthand blundering have been construed into such an absurdity; but if I had done so it would more likely have been one where "nothing" was a telegraphic error for "everything."



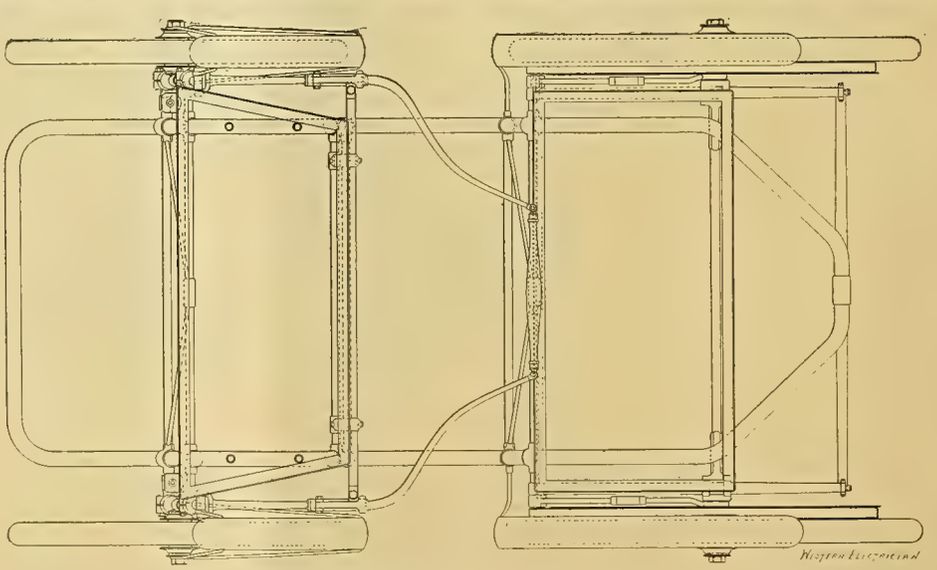
FIGS. 1 AND 2. NEW FORM OF RAIL BOND.

I cannot too gratefully speak of the attention and kindness I received from everyone, and I certainly feel that I have personally profited from my visit very much indeed.

A visit to the United States is something like charging an accumulator. It stores the visitor with energy. When I am completely discharged, and my adverse criticisms have been forgotten, I shall probably cross the Atlantic again.

Arnold's Electric Carriage.

The problem of electric traction on the public highways by independent vehicles is one that has received much attention from engineers and inventors, and several electric carriages have been successfully operated on the streets of large cities, to the great admiration of the public. One of these—probably the first electric carriage in the West—was illustrated and described in the Western Electrician of December 5, 1891, and September 17, 1892, and was later exhibited at the World's Fair. A widely known electrical engineer of Chicago, B. J. Arnold, has now entered the field with an electric carriage of new design, as shown by the accompanying drawings. As will be seen, the carriage is extremely light and graceful in appearance, and it has been planned as a road vehicle for use upon the boulevards of Chicago and other large cities. Heretofore one of the principal objections to electric carriages has been the weight, and it has been the intention of the designer of this carriage to reduce the weight to the lowest possible limit consistent with strength and safety. It will be noticed that the frame work of the machine is built of steel tubing, bent in such shapes as to be thoroughly trussed in all directions and at the same time presenting a skeleton or bicycle like appearance. Instead of carrying the batteries in a heavy body or box, the cells are suspended underneath the seats, thus being almost hidden from view. The entire machine resembles two safety bicycles connected side by side by a suitable frame work, to which is attached



ARNOLD'S ELECTRIC CARRIAGE.—PLAN VIEW.

a canopy top, and the whole has the advantage of lightness and symmetry. It is estimated that the weight of the carriage complete, without passengers, will be 900 pounds, the batteries contributing 500 pounds of this amount.

It will be noticed that the front wheels, instead of being mounted upon axles as is usual, are mounted upon independent vertical spindles carried on ball bearings with levers extending backward from the top of the spindle to the steering handle, which comes in front of the passenger occupying the rear seat. This arrangement enables the driver of the vehicle to swing both forward wheels at the proper angle to go around any curve and at the same time permits him to have his weight over the rear wheels where the power is applied, thus insuring sufficient weight over the rear wheels for traction, which is not the case with a carriage steered from the forward seat, as it often happens that there is but a single occupant in the vehicle, and as he sits over the forward wheel the carriage is unable to ascend a grade, owing to the rear wheels not having sufficient weight over them for adhesion.

The entire weight of passengers and storage batteries is carried upon springs. The weight on the forward seat is sustained upon elliptical springs, as shown, while the entire rear end of the vehicle is mounted upon carriage springs. The seats are to be upholstered in leather or other suitable material and the iron work will be highly finished.

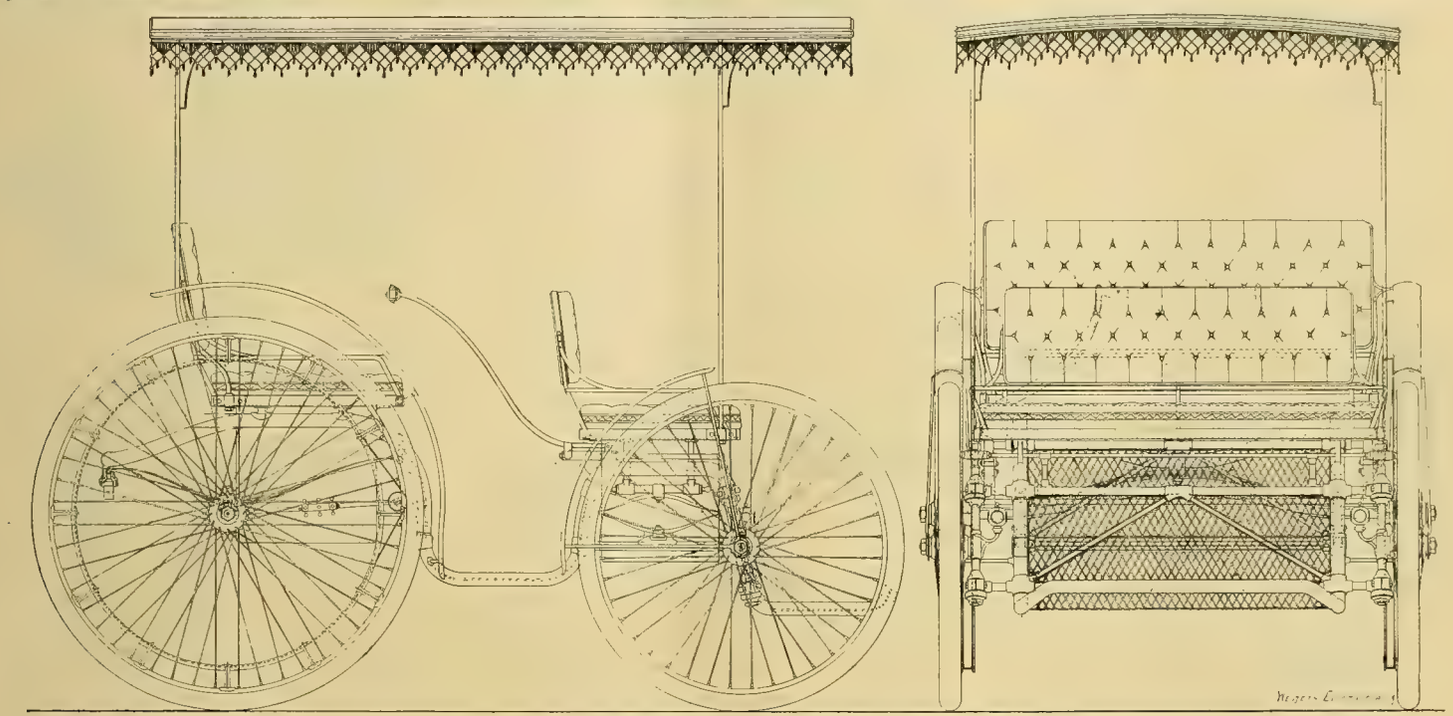
The driving mechanism consists of a one horse power motor connected to the rear wheels by means of a steel band having eyelets at equal distances upon it, which engage with small projections upon the driving pinions. This band is kept tight by means of a link which surrounds the axle and the motor shaft, and can be adjusted by thumb screws to compensate for any lost motion. The motor shaft is suspended from a link attached to the frame above, and it is held concentrically with the rear axle by means of the link, thus keeping the driving band tight at all times, or, if gearing be used, keeping the gearing in its proper mesh, and allowing the rear wheels to mount any irregularity in the track without throwing any additional strain upon the gearing. This application to traction vehicles was patented by Mr. Arnold for traction engines some years ago.

Twenty-four 75 ampere hour Pumpelly Sorley storage batteries will supply current to the motors. The controlling switch is located under the rear seat, and operated by the driver. It will throw the cells in three different combinations, thus giving three different speeds. These cells will run the vehicle fifty miles on good streets at a speed of ten miles per hour on one charge. The carriage will be provided with a reversing switch and a mercury contact switch so connected that the driver may operate them with his foot. This arrangement permits him to give his entire attention for steering the apparatus with his hand, and allows him to cut current on or off or reverse the machine with his foot.

Upon the vertical spindles carrying the forward wheels are attached two electric lamps, similar to bicycle lamps. These lamps being set on the spindles which revolve with the wheel throw the light always in the direction that the carriage is going.

Ball bearings are used throughout the entire carriage, thus reducing the frictional resistance on the machine itself to the lowest possible amount. There is a steel wire netting underneath the passengers' feet, both in front and behind, while in the rear there is a place where small packages can be strapped to the machine. The wheels will be constructed on the bicycle principle and provided with cushioned rubber tires.

The designer of this vehicle has had an extended experience in designing traction engines as well as locomotives, and the knowledge thus acquired has been utilized in planning this electric carriage. Arrangements are being made for the manufacture of the carriage, and it is hoped that one of them will soon be in operation. It is stated that the carriage can be put on the market at a retail price of $400.



ARNOLD'S ELECTRIC CARRIAGE —SIDE VIEW AND FRONT ELEVATION.

Electric Railways In Chicago.

At last week's meeting of the Chicago council an ordinance was passed which was not only of great importance to the people but which marked a step in advance, showing that the overhead trolley system, by its operation in other cities and where it has been introduced in the outskirts of Chicago, has gained the confidence and approval of those seeking rapid transit. This ordinance provided for the construction of trolley lines upon most of the cross-town roads owned by the Chicago City Railway company, and now operated by horses. It has often been contended in the columns of this journal that this system, generally speaking, is, at the present time, best suited to street car service, and it is encouraging to note that at least an attempt has been made to give Chicago the advantages of electric traction. It appears, however, that the people of the South Side will have to wait some time yet for relief. The measure as it passed the council was so liberal in its terms that Mayor Hopkins vetoed it and demanded a few concessions from the company. His Honor is in favor of insisting that a center pole overhead construction be used with ornamental poles, and that the company shall light the streets through which its tracks run free of charge to the city. To all of these suggestions the company turned a deaf ear. Samuel W. Allerton, who is the principal stock holder in the Chicago City Railway company, when asked what the company would do now that it was understood that the mayor would deny the application to change its motive power, said:

Mayor Hopkins has saved the company $2,000,000. We are overwhelmed with a demand from the public to change our motive power, and give more rapid transit by use of electricity. Real estate interests were alarmed by the growth of population along the West Side elevated lines, and importuned the Chicago City Railway company to give transit equally as rapid. It was found that the change would require an expenditure of upwards of $2,000,000, but we decided to gratify the public. Application was made to the executive of Chicago, who seemed to think the change was in the interest of the company, for which it should pay the city heavily, and denied the application. I immediately went before the Board of Directors, and suggested that we call the matter off, and ourselves $2,000,000 in pocket. This was done. The company will make no more effort in the matter, and has a good answer to the importunities of people who want to travel faster.

A mass meeting of Lake View citizens was held last week to take steps toward the establishment of better and cheaper transit for the North Side. A petition to the council was formulated and adopted, asking that an ordinance be passed, giving the North Chicago Street Railway company the right to use an overhead trolley system. A committee of five was appointed to investigate and make report on the storage battery system, with a view to having it put in use on a proposed new line through Lake View, Ravenswood and Jefferson to the North Side city limits. Promises have been made by those back of the enterprise, that if this system of electric motive power can be successfully adopted, they will give the North Siders a continuous ride from the City Hall to the city limits for one fare.

Economical Size for Arc Dynamos.[1]

C. R. HUNTLEY, Buffalo: I do not know that any one of us can make a cast iron rule and say which unit is the more profitable one for us to employ, and what I shall have to say on this matter will be confined to that which I think it is right for us to use with the long distance that we have to cover and the number of lamps we have upon the circuit, together with the floor space, capacity, etc.

When I came into the business, the company with which I was first connected was the Brush company, and afterward, by consolidation, we acquired all the reputable and recognized arc systems, and we have identified them so that our No. 1 station has absolutely one kind of apparatus; No. 2 another kind, No. 3 another, and No. 4 station another. After looking it all over, if we were to equip our plant anew, I believe we would buy as large units as exist. I believe we would take up the eighty light generators if we could not get larger. If I were to place an order to-morrow I would try to get a 100 light machine. The natural criticism of that statement is that your voltage is going to be dangerous. Not being an electrician, I cannot say; but in our experience we have had occasion to put two machines together on our dock lighting, and I have found that there is no difficulty; in fact, nobody knew the difference. If we could get that power in one machine, designed as efficiently and as free from burning out the armatures, I would be in favor of a larger unit. We are certainly working an 80 light machine, and I would not like to be on record as advocating less than a 100 light unit if we can get it.

G. A. REDMAN, Rochester: Personally I believe in a large unit, but, like my friend, we have been using five or six different kinds of apparatus, and we are situated differently from other companies in regard to the voltage. We are prohibited by our contract with the city and city council from exceeding 3,500 voltage; in the case of the Brush company, 3,400. We would like to try an 80-light machine or 100 light machine, but we are prohibited.

J. I. AYER, St. Louis: I have had considerable experience with the arc lighting dynamos of the larger units, and from the point of efficient maintenance I have not been able to distinguish any difference between those 60 light machines and the smaller. Machines equally well

1. Discussion at the seventeenth convention of the National Electric Light association at Washington, Februrary 28, March 1, 1894.

made seem to stand up. It is impracticable to build a machine of the gramme type of armature which you can easily operate at 4,000 volts. In the operation of the station we carefully noted and kept record of the line troubles on the different circuits, and the records on the 80 light circuits showed no greater trouble than those on 60 light circuits. I operated for about two years and a half about thirteen 80 lighters. In a station where the number of lamps in operation would justify the use of the large units I think there is no question as to what should be used. Of course, in small central stations where the aggregate output would not amount to more than a load on one 80 light machine, it is preferable to divide your units. The only economical question in the use of arc lighting dynamos is in the station. In the station the largest machine obtainable is the most economical. I have had the same experience that our friend, Mr. Huntley, mentions, operating stations which were the growth of time, and where we had dynamos of all sizes. So soon as practicable I made the circuits as large as our largest units, to reduce the number of circuits that we would have to care for, and the way that we were compelled to use the smaller machines was to run them in series. I was always unwilling to couple up the dynamos so as to get the voltage four or five thousand volts. I made some experiments with two 60-light machines coupled together for sixty days, and did it in wet weather purposely. We found in a circuit with 130 lights, with two 60 light machines, that it was dangerous in the station; but we guarded against accidents there. We found that the current could be detected on the ground, that by touching with a wet towel there was leakage through the insulators. I made it an iron-clad

FIG. 2. DEFECTIVE SHIP WIRING.

rule in the station that no such practice should obtain. In my experience you cannot run any higher than four or five thousand volts on a circuit; when you get six or seven thousand you are getting too high. But that is a matter of insulation; something we hope to overcome. Taking conditions as they are, I think there is no question that an 80 light dynamo is perfectly practicable.

E. F. Peck, Brooklyn: The question here presented is as to the most economical size of dynamo. To me that is a question of condition. Take the city of Brooklyn, for example. There we branch off in all directions from the central point, and we can use dynamos of smaller units to advantage; whereas, in the city of New York, the shape of the city being long drawn out, it is more economical to use larger units of machines. We find that 2,500 volts is about all we care to insulate. I am strongly in favor, therefore, of smaller units.

A. J. De Camp, Philadelphia: I never did understand why there should be any objection to the larger machine. I was asked the question what was the best machine to use. I should say the largest machine you can get, everything else being equal. Some six years ago, or about the time that the coil armature was increased from 40 to 60 lights, and done successfully, I then asked the question: If you can make a 60 light machine, why

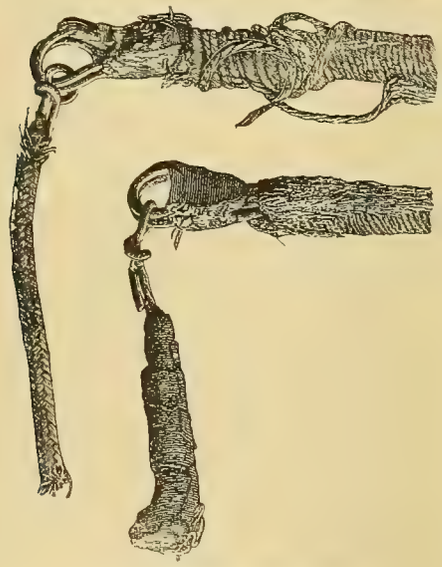


FIG. 3. DEFECTIVE SHIP WIRING.

can you not make a 100 light machine? That question grew out of the necessity which was confronting us at the time. The only answer I got was from Mr. Brush himself and he ought to be an authority on the subject—was that they could not put that machine on the market, on account of the high voltage. What objection is that to us? is the question which arises in my uneducated brain; and the answer is that it would be too dangerous. If the voltage you were using at the time, 2,000, were dangerous, if not properly controlled, the voltage of 6,000 was equally dangerous, it was a distinction without a difference. I never changed my mind about it. I believe that if a machine be properly made, if the insulation is properly cared for, as all machines should be whether of high or low tension, there is no objection to running machines of 100 lights.

I kept pegging away on that point because I was in the position that almost every station man is who has grown up with the station. It has now come to the time when the economy of space has become a factor in the proper manipulation of the property. Finally the Brush company made a machine of what they call 120 lights. We have been running that machine in our station for about three weeks, and so far as our experience has gone it is in every respect as feasible and as efficient as the 60-light machine. It is true it takes up one inch more of floor space than the 60-light machine; it is a little longer and a little wider. It has the same type of armature, and it has the same type of commutator. It has twenty bobbins instead of twelve, and they are covered up differently. We have not had the slightest trouble with it. Of course, going back to the first principles, it naturally follows that with a machine of that kind greater care should be taken in the insulation of your wire, and of your lamps for safety; but, without altering the condition of insulation of our lines from what they were when the machines were put on our circuit, we have not experienced any of the difficulties or troubles that are usually apprehended from the use of a machine of that size. This is called a 120 light machine. We have run 129 lights on it ever since it has been running, and there is capacity for some more lights; how many more I do not know. But that machine is running 120 lights nicely, and I can see no reason why you cannot run twice 120.

Defective Ship Wiring.

An agitation has been begun in England for reform in the manner of wiring electric light installations on shipboard, and if the instances of "jerry wiring" shown by the accompanying cuts are at all representative, it is

FIG. 4. DEFECTIVE SHIP WIRING.

high time that some remedial measure be put in force. The illustrations are reproduced from the *Electrical Review* of London, which says of them: "We illustrate some samples taken from vessels at different dates; they have not been doctored for the purpose of creating a sensation, but are 'living' specimens, many of them taken from well-known liners."

It is asserted that the jerry wirer has contrived to convert substantial, seaworthy boats into dangerous vessels. This remark does not apply simply to cargo boats and small passenger vessels; it is stated as an undeniable fact that some of the finest steamers which leave the shores of England are wired in a scandalous fashion. To quote the vigorous language of the *Electrical Review*, "Not only is the workmanship bad, but the material used is of the rottenest description, and nothing short of the marvelous can possibly prevent fires. The jerry wirer is rampant in this year of grace, 1894, and shipowners, heedless and ignorant of the effects of bad work, encourage this abandoned wretch to put in materials which would disgrace a marine store. We know not whom to blame the most. It is impossible to locate the entire blame on the shipowner, for presumably he is not cognisant of the responsibility he incurs when sending a badly wired ship to sea. The really culpable person is the electrical engineer, undertaker, jerry wirer, or by whatever name he styles himself; when he carries out his jerry wiring, he prepares, in reality, a ghastly death trap for his fellow men. To appeal to him would be useless. He owes his existence to the extraordinary loose conditions which prevail, and the advent of a proper supervision would be his death warrant. In attacking the jerry wirer we are not tilting at windmills; we are making an onslaught upon a baneful system which demands immediate and vigorous remedial measures."

Fig. 1 shows a specimen of jointing as practiced by the jerry wirer. An attempt has been made to join two branch wires (19/16s) to a main cable of 19/14, and as will be seen, the attempt is a dismal failure; the wires have been simply twisted together, and are wholly innocent of solder. This high class joint when finished had been simply wrapped with tape. Fig. 2 is a novel and somewhat slovenly manner of connecting three lamps to a branch main; comment is unnecessary. It is difficult to decide whether the two eye joints shown in Fig. 3 were made at sea by some deft fingered sailor, or whether they were done by a jerry wirer in the guise of a bell hanger. The evidence is suggestive of the latter. The joint shown at

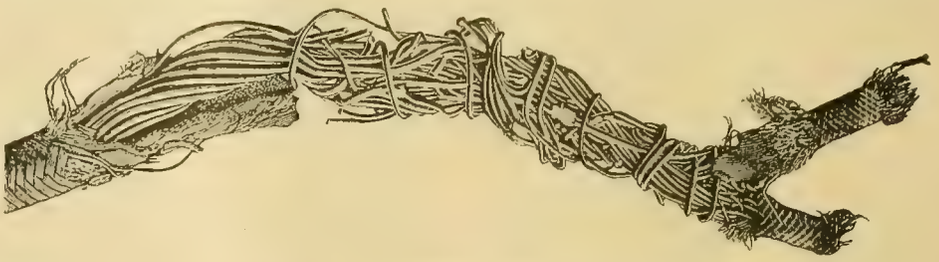


FIG. 1. DEFECTIVE SHIP WIRING.

the top of the cut was taken from a steamship of first-class rating. Fig. 4 illustrates electrolytic action in a very advanced state on an electric light cable, 19 strands being reduced to five. This is an exceedingly common form of deterioration and actually excites no apprehension. Common jute is the insulating material used on this particular sample. No mechanical protection whatever was provided for this cable, which was simply nailed to the ship. The wooden switch shown in Fig. 5 was found on board

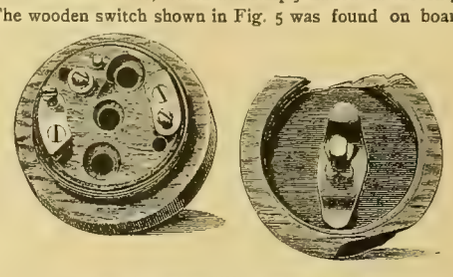


FIG. 5. DEFECTIVE SHIP WIRING.

a modern ship, and is a grotesque example of latter day "improvements." The contact piece is of brass and works stiffly on the woodwork. There is evidence of charring, due to apparent heating of the contact piece. This switch, it may be mentioned, carried the fuse wire inside, and the whole was considered, no doubt, a neat and useful combination. Wooden switches were much affected in the youthful days of electric lighting, but it is startling to find them still in use. Prof. Andrew Jamieson forwarded the specimens illustrated in Fig. 6. He remarks that not one of the joints was soldered and that he has "seldom come across more unsafe workmanship or miserably bad insulating material." The middle specimen was found joined in circuit with fifteen 16-candle power lamps.

On one ship it was discovered that the casing was torn

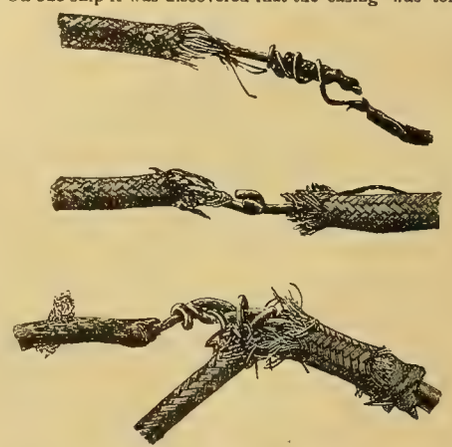


FIG. 6. DEFECTIVE SHIP WIRING.

away in one place, in such a way as to expose a bare joint. The engineer of the vessel was asked if there were many like that. "Oh, yes! Most of the joints are not tapered and never had been!" Yet no concern was felt; it was a matter that interested nobody, and no attempt was made to remedy the state of things. In another instance iron pipes were used as a protection for cables. The engineer, upon being asked whether the pipes were waterpoof, in a satirical manner replied that they were not even coal proof! The electric light on one ship failed at sea. On arrival at port tests were made to discover the fault; it was found that the casing containing the wires had been carried across the hold in such a manner, that when a cargo was shipped, the casing and wires were snapped in two; the

ends of the wire stuck out in the most ugly manner, and little was required to make a short circuit.

It is when using fuse wires that the jerry wirer's latent genius for evil is pre-eminent. The tale of a lighting circuit protecting a fuse wire is old, but it does not exaggerate the proclivities of the lighting contractor. The cases that have come to notice are numerous. A representative one is that of a fuse wire protecting four 16 candle power lamps on a 50 volt circuit; upon testing this wire it took 120 amperes to fuse it. If it were necessary, instances similar to the foregoing could be multiplied, but sufficient has been said to show the condition of much of the present ship wiring. Things have reached such a pass that respectable firms refuse to compete for ship wiring on the grounds that good work cannot be done cheaply, and it is the cheap work which is generally selected. To all intents and purposes, therefore, the jerry wirer has a monopoly, and unless stringent measures are at once adopted, his wretched work will be on every ship. The attitude taken up by Lloyds in this most important matter is puerile. In a hesitating manner they offer a set of amateurish suggestions which are unheeded by the contractor. The *Review* calls for the appointment of efficient inspectors to prevent this reckless trifling with valuable

INSULATOR SUPPORT.

property. To the Board of Trade, however, must be relegated the power to supervise on behalf of the British public.

Insulator Support.

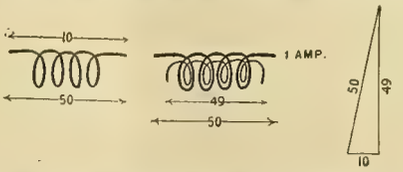
The object of the device illustrated in the accompanying cut is to provide a simple, efficient, and readily adjustable insulator support designed for cross-arms of poles intended to sustain overhead electric conductors. The invention consists in an insulator support composed of a yoke having a connecting cross-head formed with a screw-threaded shank, and a pair of parallel arms adopted to embrace the cross arm of a pole, and provided at their ends with bolt holes, a removable and replacable tie bolt passing through the bolt holes in the ends of the yoke arm, and an insulator mounted on the screw-threaded shank. This construction obviates the employment of holes in the cross-arms of poles, and possesses other advantages which may be readily recognized. The device is the invention of A. Henley, Paris, Tenn.

The proprietors of the Kewanee, Ill., Gas Light company are considering the advisability of adding an electric annex, and the local electric lighting company is said to be inclined to go into the gas business. The probability, however, is that an agreement to combine the interests will be the ultimate result.

Polyphase Transmission.[1]

By Charles F. Scott.

When alternating current was introduced for lighting it presented many new problems to the electrical engineer. Numerous difficulties and dangers were predicted by the theorist, but in ordinary service most of these have fortunately lain dormant. These difficulties are apt to appear, however, when alternating current work is attempted on a large scale. The introduction of large units, heavier currents, higher potentials or power service are apt to



FIGS. 1*A* AND 1*B*. POLYPHASE TRANSMISSION.

increase the effects of self-induction and capacity so that they will now demand careful consideration. The impetus which electrical engineering is receiving from the introduction of the polyphase system, which brings with it large units and long distances, naturally directs attention to the general problem of alternating current transmission and distribution.

A complete and exhaustive solution of this problem is by no means a simple one, and the attempted solutions generally lead to formulæ and diagrams which are possibly even more perplexing than the phenomena. If even the electrician who devotes all his energy to new problems can scarcely keep abreast of the times, it is not surprising that the practical engineer and station manager become perplexed and confounded at the apparently erratic phenomena observed in practice or described in print. Theoretical articles appear on variation in wave form, harmonies, so-called Ferranti effects, increased resistence in conductors with alternating currents, hysteresis, peculiar magnetic circuits, resonance, oscillations, lag, capacity, self-induction. Many of these articles, although evidently intended to be of service in engineering, show apparently no adequate appreciation of the practical bearing and relation of the subjects treated. Consequently the average engineer becomes bewildered and perplexed, and concludes that theoretical explanations are of little value to the practical man. There are, however, many points of great practical importance which admit of fairly simple statement and explanation. The particular element to be considered in the present paper is the transmission circuit.

Experiments Illustrating Self-induction.

One of the fundamental characteristics of alternating current working is self-induction. The effect of self-induction is most readily shown by a simple experiment. A wire having a resistance of 10 ohms may be wound in a coil. Ten volts will send a continuous current of one ampere through this coil. An alternating current of a certain frequency will require 50 volts for producing one ampere through the same wire (Fig. 1*A*). In the diagrams the numbers above the circuit are for continuous current and those below are for alternating current. If a one-ampere, 50 volt lamp be placed in series with the coil and a current of one ampere be passed through the two in series, the electromotive force required for continuous current is 10 volts on the coil and 50 volts on the lamp, or 60 volts across the circuit, and the electromotive force required for alternating current is 50 volts across the coil and 50 volts across the lamp, which gives, not 100 volts, but 78 volts measured across the two in series, Fig. 2. If two lamps be placed in multiple and connected in series with the coil, 2 amperes will require for continuous current 20 volts on the coil and 50 volts on the lamps, or 70 volts across the circuit. For alternating current, the electromotive force on the coil is 100 volts and on the lamps 50 volts, and on the circuit across the two in series, the electromotive force is 120 volts, Fig. 3.

The two lamps which are in multiple may be placed in series with a second coil so proportioned that an electromotive force of 50 volts will send one ampere alternating current through the combination, and a continuous current of one ampere would be caused by 35 volts. This combination may be treated as a unit and may be used to replace the single lamp in the above test, Fig. 2. If this combination be placed in series with the first coil, the electromotive force required for sending the continuous current through the circuit will be 10 volts on the coil

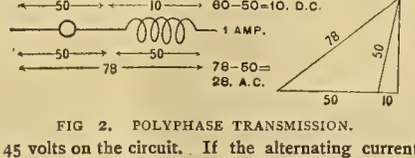


FIG 2. POLYPHASE TRANSMISSION.

and 45 volts on the circuit. If the alternating current of one ampere be sent through the circuit, 50 volts will be required across the combination and 50 volts across the coil, the same as with the single lamp, but the electromotive force across the circuit is no longer 78 volts, but has increased to 95 volts, Fig. 4.

The important facts to be noted in these experiments are: (1) that the sum of the alternating electromotive forces on the elements in series is greater than that required on the terminals; (2) that the alternating electromotive force for supplying the lamps in series with a coil is greater than the continuous electromotive force, and (3) that the difference between the two become greater as the number of lamps is increased, Figs. 2 and 3. It is also to be noted (4) that if the same alternating current be supplied through a coil, first to a lamp alone and then to a combination including lamps and a coil, a higher electromotive force is required when the combination is used, Figs. 2 and 4.

These relations, which seem rather perplexing, may be illustrated in a very simple way by diagrams. In the case of the coil alone, in which fifty volts are required for producing one ampere alternating current and ten volts for one ampere continuous current, these two electromotive forces may be represented by the hypothenuse and one side of the familiar right-angled triangle. The remaining side represents the counter electromotive force in the coil. If a second wire had been wound in this coil in parallel with the first it would be found that when one ampere is passing there is an electromotive force on the terminals of the second, or idle wire, of forty volts, Fig. 1*B*. This electromotive force is caused by the field produced by the alternating current. An equal electromotive force is, of course, induced in the wire carrying the current, as the two wires occupy virtually the same position. This counter electromotive force is seen to correspond with the third side of the triangle. Suitable measurements would show that this counter electromotive force occurs later than the current through the coil, and that its maximum value occurs when the current is passing through its zero. This relation is shown in the diagram by the 90 degree relation of the lines representing counter electromotive force and the volts required for sending continuous current through the line.

Self-induction in Circuits.

An ordinary circuit may be considered as a choke coil in which there is a single turn. The action in this case is

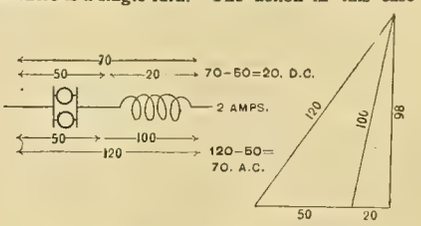


FIG. 3. POLYPHASE TRANSMISSION.

very similar to that illustrated above with a coil of many turns. The effect of self-induction in a circuit may be most readily understood by some simple diagrams. A current of, say five amperes, is described at 100 volts over a circuit of 1-5th of an ohm resistance. The self-induction of the circuit is such that five amperes generate a counter electromotive force of ten volts. Both continuous and alternating currents are used, and the generator electromotive force is, in each case, adjusted to give 100 volts at the load.

The load consists, first, of five incandescent lamps. A coil of high self-induction is then added, which increases the current from 5 to 5.1 amperes. One of the lamps is then cut out and replaced by coils of such a self-induction as to give a total of five amperes. Then all of the lamps are cut out and coils substituted of such a number as to take five amperes at 100 volts. The electromotive force required on the generator and the resulting drop, or difference of electromotive force at the dynamo and at the

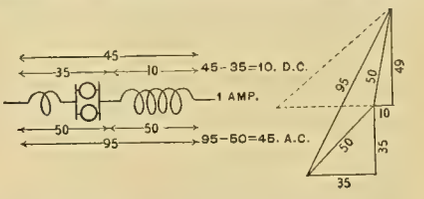


FIG. 4. POLYPHASE TRANSMISSION.

load are given in the diagrams and in the following table:

	Continuous current	Alternating Current.			
	Fig. 5.	Fig. 6.	Fig. 7.	Fig. 8.	Fig. 9.
Current in line.....	5	5	5.1	5	5
" " lamps ...	5	5	5	4	0
" " coils.....	0	0	1	3	5
E. M. F. on load....	100	100	100	100	100
" " " line	1	10	10	10	10
" " " g'n'r'tor	101	101.5	102.5	105	110
Total drop.....	1	1.5	2.5	6	10

It is to be noted that with exactly the same circuit for supplying five lamps with the same amperes at the same electromotive force, there is an increase of drop between generator and load when continuous current is replaced by alternating current. This drop is much less than the volts required for sending the alternating current through the line, and it moreover increases enormously as the load becomes even slightly inductive. Thus when the current is increased only two per cent. (from 5 to 5.1 amperes, Figs. 6 and 7) by the addition of inductive load to the lamp load, the increase of drop due to self-induction is increased from one-half per cent. to one and one-half per cent. or an increase of three-fold. When the load consists of four lamps and coils are added in multiple to take a total of five amperes, or the same as that taken by the five lamps from the generator, the drop in four times the drop when five lamps alone are in circuit. If the remaining four lamps be replaced by coils, the drop does not increase in proportion, but from 6 to only 10 per cent. The effect therefore of a slight self-induction in the load causes a much greater proportional drop than the presence of a large self-induction. A counter electromotive force of 10 per cent. is not at all likely to occur in a 100 volt line carrying small

1. Read Before National Electric Light association, Washington, March 1, 1894.

current. The figures given, however, serve as an illustration of the percentage variations which are liable to occur in other parts of the systems.

Drop in Continuous and Alternating Circuits.

The word "drop" in continuous current calculations has a perfectly well defined meaning. In the case or the five lamps which take five amperes at 100 volts through a circuit of one-fifth of an ohm as illustrated in Fig. 5, the drop is (1) the difference between the electromotive force at the generator and at the lamps, or one volt, which is one per cent.; (2) it is the electromotive force required for sending the current through the line. This is equal to the current multiplied by the resistance, and is the electromotive force

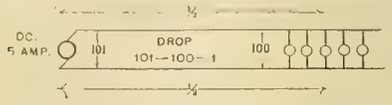


FIG. 5. POLYPHASE TRANSMISSION.

which would be required for sending the current through the line if the load be short circuited; (3) a drop of one per cent. means also that the energy lost in the line is one per cent. of that delivered by the generator; (4) a loss of one per cent. in the line also signifies that the energy delivered is one per cent. less than that supplied by the generator.

In alternating current work the same uniformity does not exist. For example, in the experiments with the same five lamps and the same line (1), the generator pressure was 101½ volts, or ½ per cent. higher than that of the lamps; (2) the electromotive force required for sending a current through a line short circuited is 10 volts, or 10 per cent.; (3) the energy lost in wires is C^2R, or 5 watts, which is one per cent. of the energy when five lamps are supplied. If four lamps and low resistance coils are connected to the circuit, the energy delivered is, say, 400 watts and the loss is 1¼ per cent.; (4) if the coils alone are supplied and their combined resistance is equal to that of the circuit, or one-fifth of an ohm, then the losses in load and line are equal and the actual line loss is 50 per cent. The apparent energy at the generator is 550 watts (110 volts and 5 amperes) and the apparent energy delivered is 500 watts (100 volts and 5 amperes), so that the apparent line loss is 9 per cent.

It is therefore evident that the several elements commonly referred to as drop or per cent. loss with continuous current are so modified when alternating current is used, that it is possible for no two of them to have the same value.

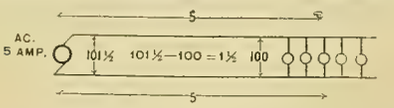


FIG. 6. POLYPHASE TRANSMISSION.

Moreover, with alternating current none of these elements may have the same per cent. value as that for continuous current on the same circuit.

Loss and Regulation.

The two vital factors in the line are loss and regulation. The losses are C^2R, and should be expressed in watts or horse power, or as a percentage of the energy delivered to the line. The practical point in regulation is the difference in electromotive force at the generator and at the load. When these two factors are known, it is generally immaterial what electromotive force might be required for sending current through a short circuited line. The word "drop" is applied to the difference in electromotive force between the generator and the load. The regulation is generally expressed in per cent. of generator electromotive force, but in this paper the electromotive force at the load will be considered 100 per cent., as this is the element to be kept constant while the electromotive force of the generator is variable, depending upon the load and other elements.

The regulation, or drop in the alternating current circuit, is dependent largely upon the counter electromotive force of the line. The factors which practically determine the counter electromotive force of the line are size of wire, distance between wires, length of circuits, frequency and current. A. E. Kennelly has given very complete curves (American Institute of Electrical Engineers, April, 1893) for determining the impedance of pole lines. The impedance factors given may be used for finding the current through a given line which is short circuited at one end when the electromotive force and frequency are known. The impedance factor of the line for supplying five lamps described above is 10, as the alternating electromotive force is ten times the continuous electromotive force for the same current when the line is short circuited. The

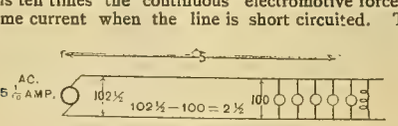


FIG. 7. POLYPHASE TRANSMISSION.

word "drop" is applied to Mr. Kennelly's article to the volts required for overcoming impedance in a circuit, and the impression that this is the same as the drop in continuous current circuits was not corrected in the paper, nor was this most practical point raised in the discussion. The relation between impedance and loss was, however, demonstrated mathematically in a communication after the meeting. The figures given in connection with the foregoing diagrams, show very clearly that a circuit having the same impedance may have a drop between the generator and the load of from 11-2 to 10 per cent., depending upon the character of the load. Impedance, therefore, does not determine regulation.

Calculation of Drop in Alternating Circuits.

The regulation of a circuit is in general determined by two elements—the counter electromotive force of the circuit and the self-induction of the load. The counter electromotive force of a line depend upon the size of wire, the distance between wires and increases directly as the length of the circuit, the current and the alternations. The counter electromotive force of a line has been calculated for a number of cases which are likely to occur in practice and the results are given in Fig. 2. The drop or difference of potential between generator terminals and the load terminals due to the counter electromotive force of the line depends, as has been shown, upon the self-induction of the load. The latter is best expressed by a power factor, or a factor by which the product of the amperes and volts giving the apparent energy must be multiplied to give the true power in watts. The power factor for incandescent lamps is 1.00, or the apparent energy is equal to the true energy. The power factor for converters loaded with incandescent lamps is usually over .99. The factor for unloaded converters varies from .50 to .80 and in open magnetic circuit converters, notably the "hedgehog," the factor may be as low as .05. The drop due to self-induction on the line (which, plus the ohmic

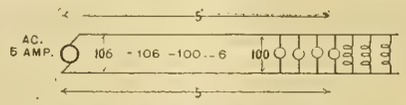


FIG. 8. POLYPHASE TRANSMISSION.

drop will give approximately the total drop) corresponding to various power factors of the load is given in Figures 12 *A* and 12*B*. The curves show that if the power factor be 100 per cent., as it is with incandescent lamps, the inductive drops for various counter or inductive electromotive forces are .02 per cent. for 2 per cent; .08 per cent. for 4 per cent.; .18 per cent. for 6 per cent; .32 per cent. for 8 per cent.; .5 per cent. for 10 per cent.; 1.2 per cent. for 15 per cent. and 2.0 per cent. for 20 per cent. The curves show that the drop increases very rapidly at first if the power factor becomes less. These relations may be elegantly determined by a simple diagram on section paper ruled in tenths. Draw an arc through a quadrant with a radius of 100. At a distance from the center on the horizontal, equal to the power factor of the load, erect a perpendicular and extend it to the arc. This line represents the counter electromotive force of the load and its value read directly on the scale gives the counter electromotive force in per cent. of the electromotive force upon the load. From the intersection of the arc draw a horizontal line outside the circle equal on the scale divisions to the per cent. in terms of the electromotive force on the load which would be required for sending the normal amperes continuous current through the line resistance. From the end of this horizontal line draw an upward vertical equal to the counter electromotive force of the line expressed in per cent. of the electromotive force on the load. A line from the center to the upper end of this vertical represents in direction and magnitude the electromotive force which must be impressed on the circuit. If from the some center an arc be drawn through this point to the base, the scale divisions on the base between the two arcs measures the total drop caused by the line in terms of the electromotive force on the load.

Self-induction in Transformers, Etc.

Self-induction exists in line, generators, transformers, secondary wiring, and sometimes in the load. In each case the effect of the self-induction upon regulation depends largely upon the self-induction of the total load which it supplies. Thus, the regulation of a generator depends upon the total self-induction of the line, transformers and load. Again, the regulation of a line supplying converters depends both upon the self-induction of the converters as well as that of the useful load. The same analysis, diagrams and tables which have been used above in connection with the line will apply to the transformers and approximately to the regulation of the generator.

An ordinary transformer has a primary self-induction

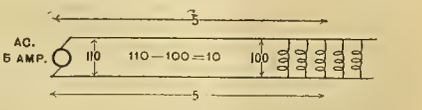


FIG. 9. POLYPHASE TRANSMISSION.

and a secondary self-induction and a mutual induction which becomes a ready source of a very complicated and perplexing analysis when the complete action is described in theoretical terms. Practically, however, the action of the self-induction in the transformer may be expresssed in a very simple way, and it is readily seen that this self-induction has a very important bearing upon the regulation of the transformer. The regulation of the transformer is very similar to that of a line, as explained above. If the secondary coil be short-circuited the electromotive force, on the primary may be adjusted so that the normal full load current passes through the apparatus. This electromotive force corresponds very closely to the electromotive force required for sending current through a short circuited line, and in ordinary transformers is practically equal to the counter electromotive force, and may be considered equal to it.

A transformer may be taken for experiment in which the electromotive forces are 1,000 volts and 100 volts. If 5 volts, or ½ per cent. are required for sending through the primary a continuous current equal to the normal full load current of the transformer, and if a similar electromotive force in the secondary is ½ a volt, or ½ per cent., then the ohmic loss in the transformer is 1 per cent. and the drop in pressure at the secondary terminals between no load and full load will be one per cent. if the self-induction be negligible. If, however, there is a self-induction so that 100 volts, or 10 per cent. is required for sending the normal current through the primary when the secondary is short circuited, then the drop in pressure is in general greater than 1 per cent, depending principally upon the character of the load. The load may be non-inductive, as lamps, or it may be more or less inductive. The experiments described above, in which a line had the same per cent. ohmic and inductive characteristics as the converter just described, apply to the converter as well as to the line. The drop on such a converter, therefore, may vary from 1½ to 10 per cent. when delivering its rated current. Arc lamps or fan moters will produce a very much greater drop than incandescent lamps. The power factor of an alternating current arc lamp varies considerably, but in a number of cases has been found between 85 and 90 per cent. The drop, when incandescent lamps are replaced by arc lamps on the transformer just described, increases from about 1½ to 5 or 6 per cent.

A secondary line, if it carry a large current, may have a counter electromotive force of several volts. This may not be enough to increase appreciably the drop in the line between the transformer terminals and incandescent lamps. But the transformer, however, delivers current to the secondary circuit and to the lamps so that the regulation of the transformer may be affected by the self-induction of the secondary circuit. Cases have occurred in which transformers of a very old type possessing high self-induction were supplying very large secondary currents, and the resulting drop in the transformers was increased several per cent. For example, a circuit of No. 0000 B. & S. wire supplying 100 amperes to 50 volt lamps at a distance of 100 feet has an ohmic drop of 2 per cent. The constant for counter electromotive force of this circuit, if the wires be 6 inches apart, is .022. The volts at 16,000 alternations are .022×100×.1×16=3.52, or 7 per cent. of 50 volts. The inductive drop in the line corresponding to 7 per cent. is .25 per cent. The power factor of the aggregate service of the transformer is the second side of a right angle triangle, of which 7 is one side and 100 is the

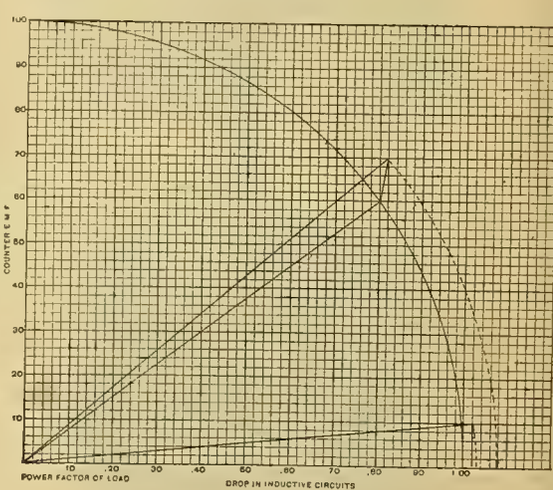


FIG. 10. POLYPHASE TRANSMISSION.

hypothenuse. This is 99.7 which is the power factor of the total load on the transformer. If the self-induction of the converter be 10 per cent., the inductive drop is 1.2 per cent.; if 20 per cent., the inductive drop is 3.4 per cent., and if 30 per cent. the inductive drop is 7 per cent. The aggregate drop in the converter and secondary circuit in the latter case would be, say, 2 per cent. for ohmic drop in transformer, 2 per cent. ohmic drop in line, 7 per cent. inductive drop in transformer and .25 per cent. inductive drop in line, or a total of 11.25 per cent. The necessary ohmic drop is 4 per cent., and the inductive drop resulting from self-induction in transformer and line is therefore 7.25 per cent. If the number of alternations be reduced to 7,200 the inductive drop would be reduced from 7.25 per cent. to 1½ per cent.

Ordinary Tests Upon Transformers.

The practical bearing of the self-induction of a transformer upon its regulation and the exact relation between the two does not seem to be clearly recognized, and even Dr. Hopkinson and Dr. Fleming, who have made very exhaustive tests upon transformers, comparing different methods of testing and different types of transformers, have not brought out this point. Attention is given to the exact form of the current wave, and measurements upon the iron losses are attempted within very close limits of error. Their measurements upon the regulation of the same transformer, however, vary from 2 per cent. to 2.4 per cent., or one measurement is one-fifth greater than the other. The presence of slight induction in the secondary load would have caused a very considerable increase, and it is probable that the difference in the measurements made were due to difference in the self-induction in the instruments used or in the load at the time the tests were made. No note is made of the effect of the self-induction of the load upon regulation, although regulation is one of the most vital points in the practical use of transformers. Even the temperature at which the drop was measured is not stated, although the resistance of a transformer when continuously working may be 20 per cent. greater than when cold. The elements of practical importance in a transformer are (1) the iron loss, in respect to the efficiency; (2) the regulation, in respect to the satisfaction of service; and (3) the temperature to which the in-

sulation is subjected, as affecting the life of the transformer. In the ordinary tests by theoretical men, the iron loss is measured to a very high degree of refinement, although the iron loss in transformers is the one thing which cannot be controlled and is certain to vary 10 or 15 per cent. in commercial manufacture of transformers of the same size. The wave form of electromotive force on different dynamos or the difference in form under different conditions of load on a circuit may make the loss under different commercial conditions vary several per cent. This renders more refined measurements of no practical use unless the conditions are stated. The temperature of the iron also affects the loss. The full load efficiency is usually given as if it had a great deal of importance whereas the losses in copper during 24 hours ordinarily amount to but a trifling per cent. of the total losses. The regulation, and the temperature to which the insulation is subjected and which it is able to stand are generally not mentioned in reports of tests. The usual investigations and the papers published on the alternating current transformer may perhaps accurately express many facts in complicated formulæ, but the practical bearing of these points in every-day working seem to be totally ignored.

Mutual Induction.

If two circuits be run on the same pole line they act as a transformer in which one circuit carrying current may act as a primary and induce electromotive force in the other

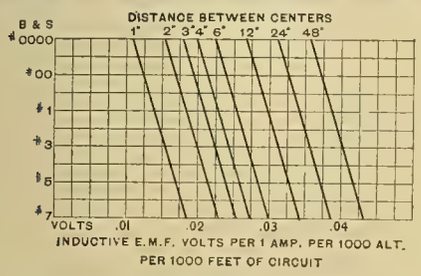


FIG. 11. POLYPHASE TRANSMISSION.

as a secondary. If the latter circuit is connected with the same dynamo and is delivering current, its electromotive force will be slightly raised or slightly lowered by the effects of the first circuit. Conversely, the second circuit will have similar effect upon its neighbor, raising or lowering its pressure by a slight amount. If the two circuits be connected to different dynamos which are running at slightly different speeds, then the electromotive force induced by one circuit upon the other will sometimes increase and at other times decrease the electromotive force of the circuit, depending upon whether the two currents at a given moment are flowing in the same or in opposite directions. This fluctuation may cause variations in the intensity of the lights supplied. It is readily detected in the service of some central stations, and is of course most marked at time of full load, as the induction of one circuit upon another depends upon the strength of current carried. The fluctuation due to this action may be readily distinguished from that due to slipping of belts or irregularity in engine speed, as the induction effect is due to the difference in alternations between two machines, and the speeds of the two machines are apt to vary slightly from time to time, giving a gradual variation in the rate of fluctuation of the lamps. The fluctuation due to mutual induction of lines occurs only at the end of the line and is not observed in the station, while the other causes affect the station lights also. The electromotive

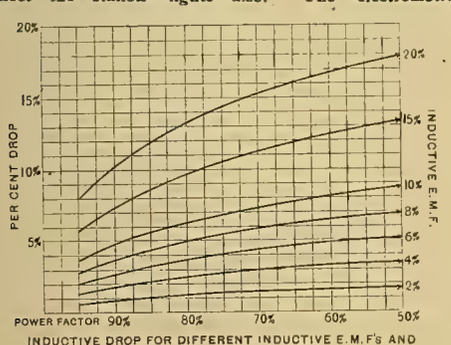


FIG. 12*A*. POLYPHASE TRANSMISSION.

force set up in one circuit by a parallel circuit depends upon the current, the distance which the lines are parallel and upon the relative positions of the four conductors. The distance between the wires may be six inches or six feet without affecting the mutual induction, provided the relative positions be unchanged. Several dispositions of circuits are shown in the accompanying figures and the number of volts per thousand feet at 7,200 and at 16,000 alternations which are induced in either circuit by one ampere in the other are given in connection with each figure. The number of volts required for producing objectionable flickering in the light depends upon the voltage of the lamps in service, the efficiency at which they are run and the general surroundings in which they are placed, notably the relation of lamps to reflectors, white walls, etc., and the general disposition of the customer.

An electromotive force of one-half per cent, induced in one circuit by another can in some cases be detected, and usually more than one or two per cent. will cause objectionable flickering.

Methods of Reducing Mutual Induction and Self-induction.

The mutual induction is reduced by bringing the wires in each circuit close together and separating the circuits. The effect of this mutual induction may be neutralized by crossing one of the lines at its middle point so that induction in the first half of the line is counteracted by the induction in the second half. It is readily noted that the effect of self-induction in a circuit is reduced as the wires are brought close together, or if each conductor be divided into several wires in multiple and separated. The effect of self-induction is diminished as the number of alternations is reduced. The following points are also to be noted in connection with inductive drop. If the power factor be nearly 100 per cent, the inductive drop increases as the square of the counter electromotive force. If the electromotive force of the circuit be increased and the same power be delivered over the same circuit, the per cent. counter electromotive force decreases as the square of the electromotive force delivered, and the inductive drop decreases approximately as the fourth power. If the number of alternations be decreased the counter electromotive force decreases directly and the inductive drop decreases as the square. The inductive drop at 7,200 alternations is less than one-fourth of that for 16,000 alternations for ordinary power factors.

Capacity in Lines.

The static capacity in ordinary lines is usually small and its effect is not of importance unless the line be very long or the pressure be very high. The general effect of capacity in the line or of connecting condensers to the line is to lessen the current from the generator, which is required for supplying inductive load and to reduce the drop due to self-induction. The use of condensers for this purpose may lead to very considerable gains in circuits where the self-induction of line or of load becomes considerable. If an inductive circuit or transformer supply current to condensers the electromotive force may increase instead of decreasing as it does with inductive loads.

Polyphase Circuits.

The subjects which have so far been considered apply to single-phase as well as to polyphase circuits. The effects of self-induction will be brought to the attention of the electrical engineer much more promptly in connection with polyphase work, however, because larger alternating current enterprises will be carried out with the polyphase system and power work involving variable power factors will be a large element in this system. There are in addition several problems which relate distinctively to polyphase working. One of these is the most suitable number of phases to be used. The two-phase system and the three-phase system are both in operation, and while it is admitted by the adherents of each system that there is no fundamental difference between them, yet each has specific characteristics giving particular advantages.

Advantages of Three Phases.

In transmission it has been recently emphasized by a good many people that the single-phase system and the two-phase system require the same weight of copper, and that the three-phase, three-wire system, requires 25 per cent. less for transmitting power under similar conditions with the same maximum electromotive force. This places an advantage on the side of the three-phase system which in many cases is of very considerable importance. The aggregate advantage, however, is greater than 25 per cent. A two-phase system laid out for the greatest economy requires that the interest on the cost of conductors shall equal the cost of the power lost. If the three-phase system be substituted the loss may remain the same and the copper will cost 25 per cent. less. This does not give the best relation between cost of copper and loss of power, so that a more economic adjustment is evidently possible.

It has also been shown that the self-induction of a three-phase three-wire circuit for transmitting under similar conditions of electromotive force is only 57 per cent. of that which is incident to the two-phase four-wire circuit. When the power factor is high the effect of self-induction of line upon regulation varies approximately as the square of the counter electromotive force. The drop due to the self-induction of a three-phase circuit is therefore only about one-third of a single-phase or two-phase circuit. This is a second advantage for the three-phase system which is of great value. A further advantage of three instead of four wires is the reduced cost of insulators and pole construction, the reduced losses due to leakage, etc.

Advantages of Two Phases.

An important point of difference between the two systems is the effect of loading one branch of the system more heavily than the others, as is common in incandescent lighting. One of the statements which remain uncontroverted in Prof. Forbes' recent comprehensive and remarkable paper upon the Electrical Transmission of Power at Niagara Falls, is in reference to the difference of regulation in dynamos for two-phase and for three-phase alternating currents. He gives the result of tests showing that the circuits of a three-phase generator differ greatly in pressure if they are not equally loaded, and states that having considered these points the directors of the company determined to reject the three-phase system. These results agree fairly well with tests which I have made. The relative regulation of the two types of machine depends very largely of course upon the character of the construction. Although it is not just to condemn one system because a certain construction is bad, yet the theoretical and practical tendencies toward the evil are largely removed by discarding the three-phase type.

If independent regulation of circuits is necessary, one circuit can be given the proper pressure directly from the dynamo and the other circuits may be raised or lowered as may be required. This involves apparatus for regulating two circuits if the station be operated by the three-phase system and only one circuit if the two-phase system is in use.

In a system where incandescent lighting is to be a prominent feature, or where load of any kind may be required upon one circuit and not on the other, the two-phase system has therefore a decided advantage in station regulation over the three-phase system. Another advantage of a two-phase circuit is that the load is separated into two divisions instead of three divisions, which is in general much simpler. A further advantage of the two-phase is in the reduction of potential for motors. Two transformers are sufficient in the two-phase system whereas three transformers are commonly used in the three-phase system. The two transformers which would be required for small motors will cost considerably less than the three transformers which would be required on the three-phase system, and the loss in transformation will be much less as there is not much dif-

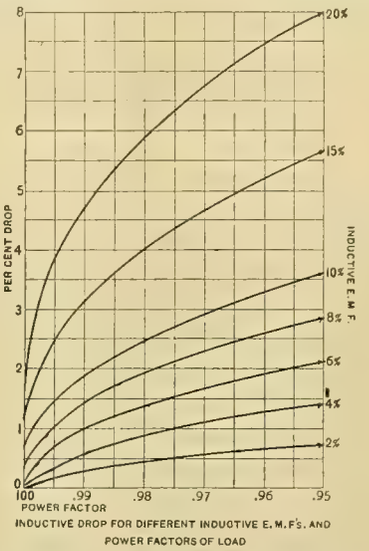


FIG. 12*B*. POLYPHASE TRANSMISSION.

ference in the cost of small transformers of slightly different sizes, and the large sizes are more efficient. The ease and simplicity of installation is also a gain for the two-phase arrangement.

A New System.

In considering the marked advantages of the two-phase system for distribution and of the three-phase system for transmission, it occurred to me that a combination of the two systems might secure the advantages of both in a combined system, and I have worked out a simple and effective method of accomplishing this result. It is well known that if two electromotive forces, differing in phase, be connected in series, that the resulting electromotive force will, in general, differ in value and in phase from either of its components. If two electromotive forces differing in phase 90 degrees, be connected in series, the resultant electromotive force is represented in direction and magnitude by the hypothenuse of a right angle triangle, of which the two sides are the two component electromotive forces. Thus, in Fig. 14, if *A O* and *O B* are two electromotive forces at right angles, and these electromotive forces be connected in series, the resultant is the line *A B* of different phase from either of the compo-

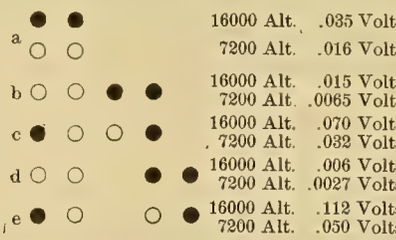


FIG. 13. POLYPHASE TRANSMISSION.

nents. It is a simple matter to so proportion the components that *O B* is equal to one-half of *A B*, as shown in the diagram. In a similar manner it is readily seen that the same electromotive force *O A* may be combined with *O C*, which differs from it by 90 degrees (but is equal and opposite to *O B* in such a way as to give *A C* equal to *A B*, but differing in direction. *B O* and *O C* added together give *B C*. The electromotive force *B C* may, therefore, be combined with the electromotive force *A O* at right angles to it in such a way as to give additional electromotive forces *A B* and *C A*, which, in connection with *B C*, give three equal electromotive forces 120 degrees apart. This is the relation of electromotive forces in the three-phase system.

The application of this arrangement to transformers is illustrated in the accompanying Figs. 15 and 16. The primaries of two transformers are connected to a generator giving two phase current. The secondary electromotive forces therefore differ 90 degrees. One secondary is made equal to 100 turns, and a loop is brought out at its middle point, giving 50 turns at each side. The second secondary has 87 turns, which is approximately equal to

[*Continued on page* 137.]

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IT now appears from the interviews published in the Chicago daily papers that the Chicago City Railway company has not been acting in good faith with the city and the patrons of the company who have occasion to ride on the South Side cross-town lines. According to the reported utterances of Mr. Allerton, who is a controlling spirit in the company, that corporation will make no further effort to secure permission to use electric motors on its lines. The fact that the mayor refused to sign the ordinance recently passed by the council giving permission to substitute electricity for animal power will be accepted as final by the company. It will not attempt to comply with the requirements which Mayor Hopkins proposes to enforce, nor will it endeavor to effect a compromise or convince the mayor that the requirements are unjust. As a matter of fact Mr. Allerton displays considerable glee over the result of the movement, and unless he has been grossly misrepresented shows that the company had no desire to introduce rapid transit upon its lines. It would appear, too, that the ordinance was drawn with the view of defeating the very object which it was supposed to be intended to accomplish. Such action on the part of a street railway corporation is enough to bring upon it the indignation of the community. It is discreditable to the corporation, to Mr. Allerton, who seems to be the moving spirit in this matter, and to the city officials, who acted in harmony with the company; and the patrons of the road should resent the action of the company at the first opportunity.

BUFFALO is the latest of the large American cities that are considering the question of municipal lighting. A committee of aldermen has recommended that the city expend $100,000 for an electric lighting plant, and the general opinion is that the municipality will embark on the venture. And this without waiting for the expiration of the existing contract with the General Electric Lighting company of Buffalo. One or two members of the committee ventured to raise a protest against this action as unfair and unjust, but the majority thought that even if the company had invested its money in good faith for machinery to do street lighting, it must look out for itself. Perhaps after the Buffalonians have had actual experience with the beauties of station management by political control, they will regret the step that seems to be impending.

AFTER careful consideration it appears that arrangements have been completed for putting in practical operation the plan of utilizing electricity in the propulsion of canal boats on the Erie canal. The superintendent of public works of the state of New York has made a contract with the Cataract General Electric company, giving it the right-of-way along the canals of the state to lay conduits, string wires or otherwise transmit electric current generated at Niagara Falls. The contract allows the company to string wires, build conduits, build a traction road for canal propulsion and establish central power stations at such points as it deemed necessary along the line of all the canals and on all canal lands. It also authorizes cables, conduits and subways to be constructed. The company may also engage in the distribution of current for general lighting and power purposes. It is provided that for these privileges the company will furnish the state at each and every canal lock power to open and close the locks and current for electric lights sufficient to light each lock. The company must conclude its work inside of three years. When the system of electricity is complete the company must furnish electricity for the propulsion of canal boats, at a rate not to exceed $20 per electrical horse power, for the season of navigation. The state may at any time condemn and take from the company any or all of its apparatus used in canal propulsion and located on state lands by paying to the company three per cent. more than the original cost. All work must be done under the supervision of the superintendent of public works. The company is composed of prominent New York capitalists.

WE commend Mr. Scott's paper on "Polyphase Transmission," read before the Washington convention of the National Electric Light association, to the thoughtful consideration of all electrical men. The subject is one of great and growing importance, particularly in localities where there is prospect of utilizing water power at considerable distances, and it is one that should be well digested by electrical engineers as advisers of capitalists and the public. It requires no mean order of ability and much mental application to gain an intelligent comprehension of the characteristics of polyphase alternating currents. The student is entitled to every aid of which he can avail himself, and in casting about for such help he can do no better than to make a careful study of Mr. Scott's admirable paper. The author has something of Elihu Thomson's faculty of describing technical conditions in simple, clear language, and he has taken pains to avoid mathematical formulæ. As for scientific correctness, such authorities as Prof. H. A. Rowland and Prof. George Forbes unite in enthusiastic praise.

In the discussion of Mr. Scott's paper Mr. Stillwell made a statement possessing an interest quite apart from the technical points under consideration. He said: "I think it is not out of place to congratulate the association upon the fact that at this meeting—and I think for the first time—an invention of great scientific interest as well as great practical importance has been first laid before this body. A year or two ago it would, undoubtedly, have first been presented to the American Institute of Electrical Engineers. I think it is a compliment to the association and an evidence of the fact that the efforts of the association to study these problems is understood and appreciated." This can hardly be construed as a compliment for the Institute. Can it be that that learned body is losing its influence?

OUR English contemporaries are making a united effort to discredit the French Pacific cable project and boom the scheme that has been advocated by many prominent English capitalists and statesmen; that is, a cable passing entirely through English territory and under complete British control. In this they are supported by Canadian and Australian officials. At Ottawa recently the premier of Queensland said in a public address that a Pacific cable under British control was necessary in the interests of the empire. Canada could count upon Queensland, and he hoped that the imperial government would also assist, but even if financial support from that quarter were withheld, he believed that the colonies would still carry out the project. Discussing the same subject, another colonial minister is reported as saying in London: "We recognize it as an imperial necessity that there should be a cable passing entirely through British territory, and tending to cement the ties between Great Britain and her great colonies in Canada and Australia. The expense of this should be borne proportionately by the imperial government and the colonies interested. The cost of the alternative cable would not be great, having regard to the enormous interests involved, and it is believed that it would pay interest on expenditure from the date of completion." It has taken the British government and the English people a long time to learn the necessity of establishing cable communication between England and Australia through Canada and the Pacific cable, and it is doubtful if they would undertake this project now if it were not for the fact that the French company threatens to become a powerful rival. The interests of this country, no doubt, can best be served by encouraging the French company, and Congress should take immediate steps toward securing control of the first link on this end of the proposed cable. By establishing communication with Hawaii this country would secure control of the situation.

IT is not charitable to rejoice at the shortcomings of others; but it must be confessed that it is a welcome relief from all the transatlantic talk about loose methods of electrical construction in the United States to hear the English electrical journals denouncing their own countrymen on precisely the same grounds. The state of affairs exposed by the London *Electrical Review*, in an article summarized elsewhere in this issue, is certainly scandalous, and shows that English electrical contractors need to be watched as closely as their brethren in any other part of the world. The samples of wiring shown are all from shipboard installations, and our contemporary asserts that "not only is the workmanship bad but the material used is of the rottenest description." The prevailing conditions are said to be "extraordinarily loose," while the "jerry wirer," an "abandoned wretch," in doing his slovenly work, is preparing a "ghastly death-trap for his fellowmen." This is certainly very vigorous language, far exceeding the terms of criticism employed in pointing out the alleged carelessness and defects in American work, but it appears to be, to a large extent, well deserved. We hope that our contemporary will persevere and assist in bringing about a needed reform.

But how about American ships? It cannot be questioned that we have a right to assert superiority in ship wiring if the "horrible examples" shown be taken as the standard of comparison. We can hardly show anything as bad as those conspicuous samples of botch-work. But we may well inquire whether there is not room for improvement in the installation of electric lighting plants in vessels hailing from ports of the United States. Naval plants are subjected to rigid government inspection, and the work is well done, but we are unaware of any legal regulation of the wiring done on our sea-going and lake merchantmen. The subject is one that may well engross the attention of Congress.

Polyphase Transmission.

[*Continued from page* 135.]

50 multiplied by the square root of 3. One end of the secondary circuit is connected with the middle point of the secondary of the first transformer, as shown, and the three free terminals wi l then deliver electromotive forces differing in phase 120 degrees. If the electromotive force on each primary be 1,000 volts and on one secondary 100 volts and on the other 87 volts, then the electromotive force measured between any two secondary terminals will be 100 volts. This three-phase circuit is adapted for operating three-phase motors. In a system of transmission two phase currents at the generator may be converted into three-phase currents, as shown in Fig. 18, and the windings may be such that the electromotive force is raised for transmission. The currents are then transmitted by three phases, effecting economy in copper. At the other end of the line a similar arrangement of transformers may be used for converting from the three-phase to the two-phase system. The two-phase currents may then be

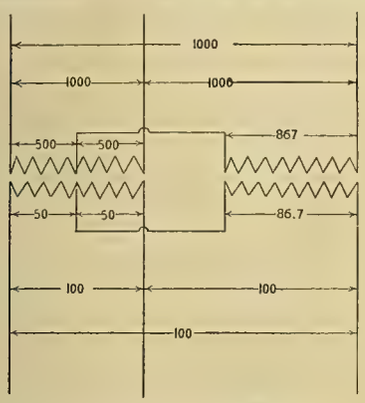


FIG. 17. POLYPHASE TRANSMISSION.

used for the operation of two-phase motors or the circuits may be independly loaded with lamps, or otherwise. If lamps be placed on the transformer which supplies directly from its two terminals, the transmission is directly from the generator without affecting in any way the other circuit as the generator terminals are connected directly to the first primaries, and the secondaries of the raising transformer are connected directly to the primaries of the lowering transformer, and the current from this is taken direetly to the load. On the other hand, if the other circuit be loaded the action here will also be on its own generator circuit without affecting the first. The current from the raising transformer in this circuit passes to the middle of the secondary of the other transformer, where it divides and flows in parallel through the two parts of the coil and two of the lines. As one-half of the current flows through each part of the secondary coil in opposite directions, the self-induction is completely neutralized and the transformers in this circuit are independent of the operation of the other circuit. It is to be noted that under this condition the line electromotive force delivered by this transformer is only 87 per cent. of that delivered by the first transformer. The lower electromotive force, however, is compensated for by the fact that the current on one side is passed through two of the lines in parallel, thus reducing the resistance of the circuit and compensating for the slightly lower electromotive force.

The effect upon the regulation of the generator when two-phase circuits at the end of a three-phase transmission line are independently loaded is found, both by theory and test, to be the same that prevails when the load is placed directly upon the corresponding circuit of the generator. A modification of this system is found in the arrangement where the three-phase current is produced in the generator and transmitted over three wires to the reducing transformers. These transformers may be arranged as described for producing two phases, Fig. 19. Loads may be placed upon either of the two-phase circuits and practically the same regulation in the generator will result that would have resulted if the generator itself had been wound for two-phases, and one of these circuits loaded. In this way it is possible to place lighting load upon a three-phase generator in two instead of three units and to avoid the bad regulation in the generator due to unequal loading.

A similar arrangement of two transformers may be used for converting three phases of one potential into three-

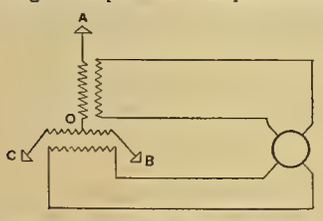


FIG. 15. POLYPHASE TRANSMISSION.

phases of another potential. This arrangement is shown in the accompanying Fig. 17.

The efficiency of two transformers arranged for convertt ing from two-phase to three-phase is reduced below that when working independently on ordinary loads by an insignificant amount. If the efficiency in ordinary working is, say, 97.5 per cent., it would be reduced to 97.4 per cent. in converting from one number of phases to the other.

The Tesla polyphase system in which the largest electrical enterprises are seeking a realization, adapts itself with marvelous facility not only to all branches of electrical industry, but also by the transformation of its phases to the utilization of three phases for gaining the highest economy in transmission, and of two phases for securing the maximum advantages in distribution.

Discussion.

Prof. George Forbes, New York: It gives me great pleasure to speak on the exceedingly interesting paper which has been read to us by Mr. Scott. The paper has really several totally distinct points of interest. Let us begin with the last part first; that is to say, I would like to say a few words simply to express the admiration I am sure every one has felt for the great ingenuity which Mr. Scott has displayed in working out this beautiful arrangement of a combination of the two-phase and three-phase systems together. We must all admit that it is an extremely beautiful idea and appears on the face of it to be a feasible method. With regard to the practicability of it, I think Mr. Scott will agree with me that it must be left to the test of experience before we can say whether it is a satisfactory method of working, as satisfactory as the two-phase or three-phase systems separately. On the face of it it looks as if it were so. I confess that I do not appreciate so much as he seems to do the superior advantages of the three-phase system for transmission over long distances. It seems to me that the two systems, so far as we can find out in practice, as to their economy, etc., have little advantage one over the other. That is the conclusion I have come to, but Mr. Scott and others hold different opinions. If the opinion be right that the three-phase system has a distinct advantage over the two-phase, then such a scheme as Mr. Scott's ought to prove of great value.

I am sure that if there are any members of the convention present who are devoted to the direct current system and determined never to hold any other opinion, whatever may happen, they will be extremely pleased to learn all the apparently intricate calculation and investigations that have to be made by the ordinary electrical engineer in dealing with the alternating current; but as a matter of fact many of these problems and apparent difficulties of calculation, to which Mr. Scott has alluded, do not become very important in the ordinary electric lighting or power station work with alternating currents of moderate dimensions. But these matters of the self-induction of the line, and the influence of different circuits upon each other, become of

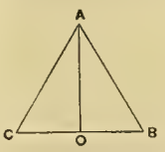


FIG. 14. POLYPHASE TRANSMISSION.

the very utmost importance when we are dealing with the transmission of power over great distances and on a large scale, and carrying a large amount of current through our mains. I need hardly say that in the course of the last year or two in connection with the transmission of power at Niagara, it has been my duty to go into these points that Mr. Scott has touched upon very fully, indeed; and in a large problem like that, the importance of these incidental matters to the alternating current, the dropping volts, the self-induction of the loop circuit of the line, etc., are so important that one cannot spend too much time in investigating them prior to the establishing of the plant. I have in the course of this work prepared for my own use a variety of tables and curves illustrating the effects and enabling one to get the results in a particular case at a moment's glance, and it has been my purpose to publish these tables and curves for the use of others; but Mr. Scott has gone a long way to make this unnecessary.

I would particularly thank Mr. Scott for this diagram which shows the inductive electromotive force in volts per ampere per thousand alternations per thousand feet of circuit at different distances between the centers. The compactness of that diagram is extremely beautiful, and I am sure that it will be of greatest value to engineers who are planning large power distribution plants in the future.

Mr. Scott has mentioned the name of Mr. Kennelly as having worked in this line. Any paper presented to the convention on the subject which did not mention Mr. Kennelly's name would be defective. Of all the beautiful expositions of profound mathematical work in the simplest language which can be understood by any student in our technical colleges, there is nothing in the literature of the day to come up to the writings of Mr. Kennelly for the last year or so. I think if we take this paper of Mr. Scott's in conjunction with those which have been written by Mr. Kennelly on the same subject, any engineer has got before him all that is required for calculating the effects of self-induction and capacity upon the circuit; that is to say, upon the efficiency of the circuit and upon the drop volts on the circuit. A little more has to be done, however, and that is the effect of resonance. The question of self-induction in the circuit is too full. We first have to deal, as Mr. Scott pointed out, with the whole circuit as forming one loop within which lines of force are formed which cut both conductors, and therefore produce electromotive force, and then you have to consider the back electromotive force which is induced in the conductors themselves. Now if we have a conductor, an inch in diameter we will say, if that were built up of a

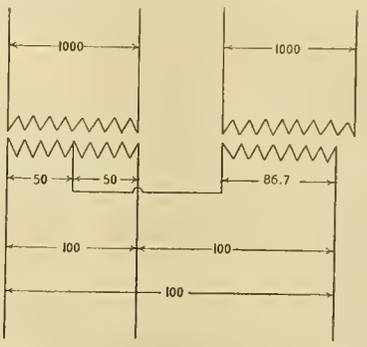


FIG. 16. POLYPHASE TRANSMISSION.

number of wires, a current suddenly started in these would induce a back electromotive force in each of the others, and therefore, every one of these wires would be acted on by the others, but it is obvious that the central wire of the bundle would be acted upon more by the others than any other; and, therefore, the back electromotive force would be the greatest in the center of the bundle. Instead of a bundle of wires we have a solid conductor, but the effects remain the same and the back electromotive force in the center of the conductor prevents the current from passing through the conductor and as it has to pass over the outside of the conductor there is a resistance to the passage of the current, and that is the skin resistance. These two elements have to be taken care of, and also the question of capacity. Capacity may tend to diminish the drop in the line. Now in regard to the lines of force that are formed in the loop of the circuit, as a matter of fact, even though electromotive force produced by this line of force, being enclosed in the circuit, even though that electromotive force may be considerable, it does not necessarily imply that the whole of that electromotice force is taken off from the applied electromotive force. That is to say, suppose we found in a long circuit going from Niagara to Buffalo that there was 1,000 volts in the circuit due to this self-induction, that does not necessarily implo that there is a drop of 1,000 volts, because from the sketches which Mr. Scott showed you the electric electromotive force is not in phase with the current. In fact, the chances are that it is nearly 90 degrees away, and therefore, the actual drop is much less than that. But here is a case which we have to consider and which is of the utmost importance. Mr. Scott has spoken of the interference of separate circuits upon each other. If he had considered the question of these circuits, two different circuits, being the circuits of a two-phase circuit of a distribution, one circuit being a quarter of a period behind the other, then we have a very serious interference. Suppose this current is changed from positive to negative. At the moment when it is zero there is a maximum electromotive force cutting the field, and that maximum electromotive force cuts the other conductors which carry the current a quarter of a phase behind, at the very moment when that current is at its maximum Therefore the electromotive force induced by one circuit upon the other is in phase with the current in the other conductor, and the pole of the electromotive force thus generated is a drop in the electromotive force of the other circuit. For this reason you will see that it is the utmost importance in a large station where the polyphase system is employed to consider most carefully the arrangement of the conductors in your subways or on your poles; so that the interference of one circuit upon the other shall be a minimum. This interference between the two circuits is of very great importance, far more important than the self-induction of one of the circuits upon itself; and it is largely owing to the trouble that may arise from this and largely owing to the trouble which may arise from capacity,

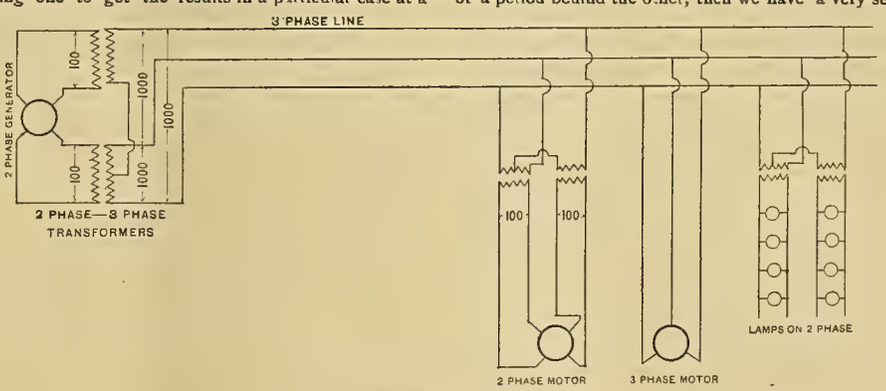


FIG. 18. POLYPHASE TRANSMISSION.

that I have to look most carefully into the subject and have found the lower the frequency the less do these things trouble us. It is largely, I say, owing to these reasons that we determined at Niagara to reduce in our dynamos the frequency to as low a point as was consistent with the construction of good, sound generators; and that is largely the reason why we have reduced our frequency to so low as twenty-five periods a second.

I take this opportunity to say a few words not directly on the subject in hand. Many persons have been surprised that the Cataract Construction Company and myself have taken no notice of numerous fault-findings and mis-statements that have at different times appeared with regard to our work at Niagara. We have not the slightest intention of paying any attention to these whatever. All that we want to do is to have our work done properly, and it is of no moment to us what opinions others may hold. We have not adopted any particular system; we believe that by the construction of dynamos of two phases we shall be able to meet all the requirements that will come to us. We are, however, ready to utilize every invention of merit. We have ordered the construction of a certain number of dynamos by the Westinghouse company; they are devoting their energies unsparingly to producing splendid machines and we are confident of the final result. I think it advisable to make these remarks, because it is not often that one happens to meet one's friends in this way; and I am glad to explain why we do not consider it necessary to take any notice of such criticisms as have appeared.

PROF. H. A. ROWLAND, Baltimore: It is with great pleasure that I rise to say a few words with regard to this invention of Mr. Scott's. As far as I can see, it is one of the finest things that have come out in recent years in this country. Very few of us expected that we would be so soon able to transform a two-phase system into a three-phase, or any number of phases. It gives us possibilities in the working of motors, etc., which we had not before, and I think this paper marks an era in the science of the polyphase system. It is curious that I happened to be writing a paper at the present time upon something on this very subject—the subject of transforming one number of phases into another number that is, two phase into to three phase, etc. I think I have also solved the problem of transforming any polyphase system into any other polyphase, also with any different period of the current. That is a little broader than this; at the same time, my method is not in any way so practical as this, and is not so simple, and in no way bears comparison with this. Although, however, a little broader aspect, as I can change the period of the current at the same time that the number of phases is changed, it is not, however, practical, like this beautiful method of Mr. Scott's.

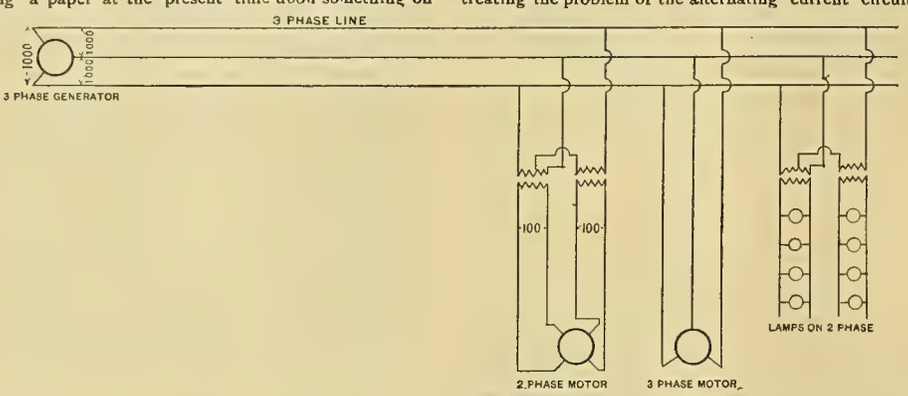


FIG. 19. POLYPHASE TRANSMISSION.

In regard to the period of the current, this is an important question in long distance transmission, in the use of motors of the Tesla polyphase type or the alternating current motors of all sorts. Although I quite agree with Prof. Forbes that a low period is very excellent in many respects, I was not able to agree with him as to the exact figures. When you get down very low, things happen that would not happen with a reasonable frequency. I have been studying the subject especially of the Tesla motor, and I see no reason in that motor for lowering the frequency, as good motors can be made for a reasonably high frequency as for a low one. When it comes to the subject of transformers, of course, the larger the period, the better the transformers become, and the smaller the period of oscillations of the current, the larger the transformers, etc.; so that there is some limit to this question of frequency. I have only to say once more that this invention of Mr. Scott seems to me to mark an era in the science of this current.

MR. SPENCER: In the formulæ of Mr. Scott he assumes his load at the end of the conductors. In actual practice the distribution of the load is over the entire conductor, except in using the feeder system in the mains, and of course this would not come in. In nine cases out of ten the load is distributed over the conductor, and not from the station. I do not see how it is possible to apply his load factor to that case. Of course, we must assume that each converter adds to the load factor. I would like to ask how he would apply that load factor when the load is distributed along the line, so that we can get an accurate idea of the size of the conductor or percentage of drop in the line.

MR. SCOTT: In the case in which the load on the circuit is distributed it becomes more complicated. It would be necessary then to take each part of the circuit and calculate the amount of electromotive force in it, and so on, for each part of the circuit, and the problem in general would be very similar to the calculation of the drop in different parts of a continuous current circuit, which is much broken up, and the load distributed, and the wires inter-connected. It becomes quite a difficult problem to apply the simple Ohm's law in a case of that kind. In practice, however, the counter electromotive force in primary circuits of one or two thousand volts extends over a small area—a mile or so—and with ordinary currents, up to one hundred amperes, is not such as to cause effects of very great practical importance. That is shown from the fact that in the circuits ordinarily operated, these effects have not been very prominent. They have not interfered with the working of central stations of pretty large capacity. For instance, at the World's Fair the circuits there were those of the largest incandescent lighting plant which has been installed; and one of the lessons of the World's Fair is that a large alternating incandescent central station can be operated, and that these effects of self-induction and capacity, which, under certain conditions, may give rise to difficulties, in the operation of this large central station, gave no disadvantageous effects. In general, the inductive drop in circuits for incandescent lighting is only a small percentage of the ohmic drop; and it is an extreme case when the drop due to induction equals the drop due to the resistance of the conductor.

I was a little afraid, in presenting some of the subjects taken up in the paper, that there would be somewhat of a scare with regard to the use of alternating currents, and that it would be apprehended that they would give rise to some trouble; but usually if a subject of this kind is taken up in the right way, the difficulties may be overcome by the right kind of engineering. The observance of a few of the precautions mentioned, the running of two wires in the circuit close together, and some other practical points of that kind, which will readily suggest themselves, may be handled successfully if one studies the diagrams and makes use of them, taking his own problems, and working out the exact electromotive forces and the exact effects of the conditions he has; this will give him an accurate notion of the extent of these effects.

I heartily agree with Mr. Forbes in his remarks concerning Mr. Kennelly. The article which he brought out a month or two ago treating the problem of the alternating current circuit in its relation both to self-induction and capacity and insulation resistance is a very comprehensive and elegant solution of the general problem. In ordinary working, however, capacity will have very little effect upon the practical conditions with which the ordinary central station man will come in contact. It is only when we get up to very high voltages or very long lines that the effect of capacity will enter in a marked degree into the operation of the circuits. The so-called skin resistance, or increase of resistance of the conductor, due to the uniform distribution of electric currents referred to by Prof. Forbes, in ordinary working may be very largely neglected. This effect decreases as the number of alternations increases, so that with sixteen thousand alternations the increase in resistance in a conductor half an inch in diameter, is only three per cent. or thereabouts, so that ordinarily this is an insignificant amount. In order that the resistance shall not exceed this, with low alternations, three or four thousand, the diameter of the wire must be something like an inch or an inch and a half.

Prof. Forbes pointed out that the action of one circuit on the other is such that the electromotive force induced is in phase with the electromotive force on the first circuit, and the latter causes a greater drop than would be caused if the two circuits were at the same phase. This is true, and the reflex action is an interesting one; the action of one circuit on the other is to decrease the electromotive force, and the reverse action of the second circuit on the first is to increase its electromotive force, so that circuits become unbalanced—the electromotive force of one circuit increasing, and that of the other decreasing.

MR. STILLWELL, Pittsburg: I have been pleased to note the interest which those members of the association who are managers of central stations have taken in Mr. Scott's paper. One of the things which manufacturing companies have to contend with, and one of the obstacles which is in the way of a more rapid development of new apparatus—the turning out of practical alternating current motors—is the fact that the time of a considerable part of the electrical staff of the large electrical companies is taken up in answering questions—largely in the line of the points covered by Mr. Scott's paper. The operators of central stations employing alternating currents have run across these phenomena from time to time and have not understood them—none of us have understood them thoroughly until recently—and they naturally call upon the engineers of the manufacturing companies to help him explain them. Every member of the association should make it his business to study this paper, and there is nothing in it which any central station manager need fail to understand. I think it is not out of place to congratulate the association upon the fact that at this meeting—and I think for the first time—an invention of great scientific interest as well as great practical importance has been laid before this body. A year or two ago it would, undoubtedly, have first been presented to the American Institute of Electrical Engineers. I think it is a compliment to the association; and an evidence of the fact that the efforts of the association to study these problems is understood and appreciated.

The paper is especially important in view of the fact that we are just now approaching the time in this country when there will be a necessity to supply arc service and motor service from our incandescent circuits. Many of you have already felt the pressure which is being exerted to drive you underground with your circuits. When that time comes the importance of being able to supply all kinds of service from one system of conductors will be great.

In regard to criticism made by Prof. Forbes: There has been some controversy over certain points which are familiar to the electrical fraternity. We claim that the plans at Niagara Falls are substantially those laid out by Mr. Tesla several years ago. The statement we issued, as nearly as I can recall, was this: The plans which have been adopted by the Cataract Construction company for its work at Niagara Falls are simply the Tesla polyphase system, as developed by the technical staff of the Westinghouse Electric & Manufacturing company. Prof. Forbes says that statement is not correct. From a lawyer's standpoint it is incorrect in this respect—my attention having since been called to it. The Niagara Falls company has ordered three two-phase generators; they have not ordered any motors. The latter will be one or two-phase. If they are two-phase the statement stands without amendment; if they are one phase it also stands without amendment—because the language is this: The Tesla polyphase system as developed by the Westinghouse company. We made no small exhibit at the World's Fair in the power transmission department. We had had a 500 horse power generator, driving a 500 horse power motor and a smaller one. It was the alternating current system. It was the constant potential type, and the motors there shown were of the two-phase variety. The frequency was thirty periods per second, or 3,600 alternations per minute. The potential was 400 or 500 volts. We showed motors of the non-synchronous and synchronous type. We did not show single phase motors in operation, but they could have been run by these generators. In the case of Niagara Falls, we have the frequency reduced to twenty-five periods; but this difference is hardly sufficient to differentiate between the two systems. I do not suppose that in the strict sense any difference in frequency could be taken as a line of demarkation between the two systems. The potential at Chicago was 400 volts, and at Niagara it will be 2,000 volts, for certain reasons. The difference of potential does not differentiate between two systems; it is selected with reference to the distance over which we are to transmit the power. Electrically speaking, these are the only differences between the plant at Chicago, and the one at Niagara.

PROF. ROWLAND: As I know all about this Niagara Falls affair, and know exactly what was recommended and what was not recommended, I may say that Mr. Stillwell's statement is correct. The things advocated are not the things which are now there.

Cost of Generating Current.[1]

It is somewhat unfortunate that it is the duty of this committee to procure and report facts instead of fancies. We listen here to many fine economies and ingenious methods of saving, and if we could report what a given installation ought to do theoretically, instead of what it does do practically, we could render a report more in keeping with the progressive spirit of these meetings.

We are requested, however, to furnish this convention with the facts regarding the amount of coal used in actual practice to produce a given quantity of electricity. The information was obtained by correspondence, and furnished the committee in amperes, volts, and hours on each circuit, and the amount of coal used covering this period, including that used for banking fires, etc. The aggregate electrical output for twenty-four hours was then calculated and compared with the total amount of fuel used, giving the watt-hours per pound of coal. All improbable and apparently erroneous reports were discarded, and the tabulated statement herewith comprises intelligent replies from a large number of the electric stations, including many of the leading corporations. The great saving in operating in large units and running continuously is plainly shown by the report which shows 208 watt-hours per pound of hard screenings where about 8,000,000 watts were generated, running full twenty-four hours, as against the report which claims only 30 watt-hours per pound of soft coal, the total output being less than 60,000 watts and the service being furnished only seven hours. The best reports do not compare favorably with the results secured in generating power for manufacturing purposes.

From this estimate of engine and dynamo loss, 1½ pounds of coal should produce 402.24 watt-hours. We have a report from the Chelsea Jute Mills of Brooklyn, N. Y., covering a period of six days, where an average of 653.3 indicated horse power was developed from a coal consumption of 1.482 pounds per indicated horse power per hour, the load varying from 495.21 to 764 96 horse power.

This equipment consists of Corliss compound condensing engines and vertical tubular boilers. The plant was in operation 10 hours each day. The figures given cover

1. Report of committee on data, National Electric Light association, Washington, February 27, 1894.

the whole amount of fuel used, including banking, etc. The fuel used was George's Creek bituminous coal.

In order to facilitate this comparison, we have prepared a table based on 90 per cent. mechanical efficiency in the engine and the same efficiency in the dynamo.

Then $\frac{746 \times .90 \times .90}{\text{coal per hour}}$ = watt hours per pound of coal. And

Coal per hour per I. H. P.	Watt-hours per lb. of coal.
1.5 lbs. should produce	402.84
2 " " "	302.13
3 " " "	201.42
4 " " "	151.06
5 " " "	120.85
6 " " "	100.71
7 " " "	86.32
8 " " "	75.53
9 " " "	67.14
10 " " "	60.43
11 " " "	54.93
12 " " "	50.35
15 " " "	40.28
18 " " "	33.57
20 " " "	30.22

If our percentage of efficiency is correct, and if we could have a fairly uniform electrical output, this plant ought to produce over 400 watt-hours, or double that of the most favorable report given us, more than double that of the next best report, thirteen times the efficiency of the plant making the lowest report, and between four and five times the average efficiency of the whole report.

No attempt has been made in this report to classify equipments, as was originally intended, but with the information here furnished as a basis, the work can be readily classified, additional information secured, and the original scheme of establishing an average basis of efficiency for the several lines of equipment can be carried out.

The correspondence shows a marked interest in the work, and many returns were accompanied by a request for information showing how their report compared with others. We believe the tendency of the work is to encourage more careful records, which in return assist in locating and eliminating losses, and we hope future reports by this committee will show a much better average than 91.7 watt-hours for one pound of coal.

Hours.	Amperes.	Volts.	Watt-hours	Pounds Coal	Kind.	Watt-hrs per lb. Coal
24	583	115	1,609,070	10,800	slack	150
16½	101	120	187,860	2,940	"	64
14	—	—	386,385	3,755	slack	103
—	—	—	10,989,870	64,155	slack	171
6	25 inc. 18 arc.	1,000 1,500	312,000	4,200	—	72
6	800 inc. 6.8	62 2,750	361,800	8,000	slack	45
9½	200	1,100	2,090,000	39,750	Ind. block	53
24	10	117	259,600	16,420	" "	166
22	875½	1,180				
7	4¼	2,000	69,580	2,000	soft	30
10	225	110	247,500	4,400	slack	56
14½	20	1,046	381,023	7,300	soft	52
7	6.8	1,832				
6	7	2,640	170,880	1,000	pea	110
14.6	—	—	316,360	6,936	slack	46
6.5	—	—	401,248	5,469	"	73
24	39	1,050	982,869			
8½	9.6	2,068	172,058	30,852	slack	42
24	296	500	355,200			
15	150	120	270,000	5,925	"	46
13	400	113	587,600	7,000	Pekay	95
10	10	810	81,000			
6	300	120	279,000	4,000	—	70
	10	1,050				
8	19	1,000	152,000	1,404	slack	108
8	113½	110	99,550	1,584	—	79
7	6¾	560	20,460			
24	4,409	122.1	12,920,136	70,382	screenings	183
inc 24	84	1,100	2,217,600	88,220	hard sc'gs	208
arc 24	80	2,000	4,840 000			
pwr.24	145	550	1,914,000			
—	200 inc. 24 arc. — pwr.	125 1,550 —	376,000 421,600 46,000	7,942	Cumberland and sc'gs	106
15	234	60	189,100	6,000	—	31½
4	6.8	500				
7	285	54½	283,820	5,459	Pthg. nut and slack	52
12½	208	52				
inc. 24	369	110	974,160	12 267	soft	186
pwr.18	[illegible]	500	586,740			
arc.—	—	—	720,000			
6	200 inc. 10 arc.	110 inc 50 arc	132 000 3,000	2,000	bit slack	67
6	141	108	91 368	1,400	Lehigh pea	65
14½	26	1,000	377,000	4,200	buckwheat	90
15 inc.	108	1,135	1,838,700	19,600	—	132
18 poner	65	525	614,250			
15	60	1,100	990,000	8,360	ant. blwt.	110
inc. 11	20	1,000	272,250	3,257	Vgy lump	83
arc. 8½	9½	1,000				
12	28	1,000	336,000	3,500	Pardee soft	8%
inc. 13	400	62	552,550	6,000	ant blwt.	92
arc. 11	9½	2,700				
16	46	1,070	787,520	6 500	bituminous	121
pwr.12	160	203	389 760	27,366	Y'ghioghény	104
inc 24	775	132	2,455 200			
inc. 8	240	110	211,200	3,000	bituminous	98
arc 7	8½	1,375	81,812			
inc. 15½	230	104	370,760	3,360	slack and nut	111
arc. 6	8	45	2,160			
inc. 15½	15	52	12,000	6,100	bituminous	88
arc 13	10	4,050	516,500			
inc. 14½	20	1,000	290,000	6,048	buckwheat	126
arc. 14	10	3,400	476,000			
15	1,600	62	1,248 000	6 600	buckwheat	192
24	373	112	1,002,624	8,190	Pittsburgh	122
14	223½	1,000	312,666	2,880	Leh V. pea	109
7½	310	115	267,376	3,500	bituminous	76
inc. 6½	156	120	121 680	1,681	Cumberland	85
arc. 6	30	120	21 600			
inc. 24	500	112	1,344 000			
arc. 8	100	9.6	7,680	16,000	hard rice	152
pwr.24	200	225	1,080 000			
16.3	33 56	1,000	547 028	4,805	buckwheat	114
inc. 12	25	1,000	300 000	4,800	bituminous	71
arc. 8	8½	1 000	42,800			
inc. 15	26	1,000	390 000	7,380	slack	68
arc. 7	350	45	110,250			
inc. 7	180	110	138 600	6,760	Sidney	46
arc. 12	9 5	3,700	307 800			
inc. 18	30	1,100	594,000	4,300	buckwheat	170
arc. 12	6½	1,800	140,400			
6½	122	110	87 230	1,400	bit. slack	62
8	inc. 19.25 arc. 9.6	1,100 1,800	284 600	2,000	pea	143
25	1,200	125	3,760,000	55,420	soft coal	68
10	220	112	246,400	2,100	coal	117
10	217.7	113	246 091	3,320	lump	46
6	inc. 22 arc. 6.8	1,060 1,500	201,120	1,800	—	112
6	130	112	72,800	1,800	slack	88
6	1200	125	135 000	2,400	bituminous	56
10.46	—	—	1,180 306	16,053	good lignite	73
14	200	110	308 000	12,000	slack	80
11	10	1,500	165,000			
11	20	1,100	242 000	3 200	McAl. lump	76
7½	203	115	171.197	3,640	Iowa slack	47
14	inc. 30½ arc. 62	1,000 102	501,256	7,500	buckwheat	67
inc 7½ arc. 7½	14 10	54 1,000	5,670 75,000	3,200	coal	25

Average watt-hours per pound coal 91.7

Discussion.

Mr. Swetland: I would like to say that it is the belief of the committee that we did not secure reports from the best stations, and that this average might have been lowered materially if we could have secured reports from stations showing better returns. If I may be allowed to suggest, I should like to see the committee on data divided geographically and about one hundred reports from the leading stations from all parts of the country tabulated for our next meeting. I think this could be done if some one man would make it his business to sell what were the results in New York, and another in Chicago, and make a personal investigation of this work instead of leaving it for correspondence. I think we could make a more favorable showing in this way.

I would like to call attention to one point, and that is the apparent inaccuracies in a great many of the returns. Out of two thousand inquiries sent out we received replies from something like eight hundred and less than one hundred suitable for our uses. This report seems to develop one idea, and that is the necessity of more accurate records in the central stations, and I believe that if this can be accomplished it will stimulate economy in the end.

Mr. Burleigh: I understand this seven pounds of coal per horse power hour to be the average according to the report. If this is the idea it seems far from a fair average.

Mr. Swetland: If our assumption of ninety per cent. efficiency in the engine and the same efficiency in the dynamo is correct, then it would take seven pounds of coal to generate a horse power hour.

Mr. Nichols: It seems to me that the result of the collection of this data is to show that electric light plants must be singularly inefficient, when the average shows a consumption of seven pounds of coal per horse power hour.

Mr. Vail: In order that a report of this kind may be fully understood, it appears to me that it would be quite proper that there should be a classification of the equipments upon which this report is based. The committee says that no attempt has been made to classify equipments. Another important point is that there is no classification as to the quality of the coal. We have two grades of coal, pea coal and George's Creek bituminous coal. All of us who are familiar with the production of steam power know that there is a great difference in coal for steaming purposes. There would be a difference of 50 per cent. at least in the pounds of coal per horse power according to the quality of coal used. The committee concluded with the hope that future reports would show a better average than 84 4 watt hours for one pound of coal If you take the stations as they are installed throughout the United States I doubt if the committee can get a much better average under present conditions. At the time of the installation of these stations, it was not a matter of economy with many of them; it was a matter of getting in as quick as they could to do business. We have advanced the business here more rapidly than anywhere else in the world and probably at the expense of economic operation. The 88.4 watt hours per pound of coal is about seven pounds of coal per hour. I know of a large number of stations, probably a hundred, running on that basis. I can point to fifty other stations which are producing a horse power hour with four pounds of coal, and have been doing it for several years. I can point to stations of recent construction which are producing a horse power hour on an average of two pounds of coal. That is based on a good quality of screened coal, or clear anthracite pen coal.

Mr. DeCamp: I think that this is not thoroughly understood. According to the estimate of the committee it would take about five horse power to run an arc light. I cannot bring myself to believe at this late day that such is the real condition of affairs. I do not think that it can be possible that it takes thirty-five pounds of coal per horse power hour to make one arc lamp.

Mr. Smith, Philadelphia: I call attention to the first sentence of this report; we are reporting on what we found. There are many more stations taking 10 horse power than three, and the astonishing thing is how few of them know it. They have a test made of their boilers and engines and I have been in one or two of them and I know how they make them—one man to open the furnace door and another man to throw the coal in. Any station using ordinary engines, non-condensing, non-compound, doing it on seven pounds of coal per horse power hour, including banking and perhaps running for an economical load six or seven hours in the evening, is doing very well. We make the report that that is what the average station is doing and the next point is what is the best means to take to improve matters. The majority of these stations could be very much improved with a little extra care.

Mr. DeCamp: The explanation brings the report a little nearer to my comprehension. You take the coal that is designated, and it runs from the best quality of steaming coal down to coal having very little steam-making qualities. I have found in my own experience that in using coal all the way from $2 a ton up to $4 a ton, under most excellent conditions for making comparisons, that the $4 coal was the cheapest fuel by 25 per cent; so that if you take into consideration the difference in the variety of coal, all of which goes into the average, the great variety of boilers and engines, and all that sort of thing, I think the statement is a fair one, and that it would fairly represent the coal consumption of the stations as run to-day on an average. I say in a general way that including what Mr. Smith says of the banking and the use of labor such as we are obliged to accept, I think that we in Philadelphia in most of our stations—the more modern ones—have got down to about four or four and a half pounds of coal, but that is with the very best coal we can use.

Mr Van Trump, Wilmington: I notice the committee tabulates 90 per cent. as engine efficiency and 90 per cent. as dynamo efficiency. The results tabulated in the report refer to the translating devices on the line, and the schedule says three pounds of coal per indicated horse power shows 201.42 watts per pound of coal. I think that with a station that is burning three pounds of coal per indicated horse power, it is impossible to get 201 watts on the line. I do not think any central station engineer who is running on three pounds of coal could get 201 watts, but only 186, out on his line, from which these results are tabulated.

Mr. Swetland: The statement is simply made up for use in the matter of comparison and of course the 90 per cent. of efficiency in the dynamo means directly at the machine, and no loss by resistance in the wire on the circuit is taken into consideration.

Faults Incident to the Protection of Lighting and Power Circuits.[1]

By Lucius T. Stanley and Walter E. Harrington.

In the present state of the art there are two common methods of protecting electric circuits, viz.: By means of metallic fuses and by means of magnetic cut-outs. It is the purpose of this paper to discuss some of the faults incident to these two systems, and, as far as possible, to suggest a remedy.

Arranging the matter in a consequent manner we will first consider metallic fuses. To adopt the language of a noted company, which is a large manufacturer of metallic fuses in various forms, "fuse wire is a safety device designed to break the electric circuit when an excessive current passes, and it breaks the circuit because it is heated to a temperature at which it melts."

Such a device as is thus defined would be a perfect protector to electric circuits if it were possible to predetermine absolutely, first, the current it will safely carry indefinitely, and, second, the actual current in excess of this safe normal load that will "blow" the fuse instantly, under any and all conditions of lapsed time, character of service, etc.

That it is beyond the range of possibility to so predetermine these conditions, to a degree even approximately near to the perfection necessary to the scientific and proper working of any modern electrical system, has been proven by such investigators as Preece, Mathews and others, who have from time to time published to the world the results of their researches, and it has been the privilege of the writers, by careful experiment, to not only corroborate many of the statements made by these experts, but to discover other novel phenomena, which have, perhaps, escaped their observation, and which it is proposed to set forth and discuss at some future time.

As demonstrated by these gentlemen, the principal causes which thus render it impossible to devise a metallic fuse that is absolutely and under any and all circumstances a protector to an electrical system are the following:

1. Lack of uniformity in proportioning and mixing the constituent alloys of the fuse, also in the methods of drawing the wire to a uniform geometric cross-section and in preparing the fuse for the market.

2. Lack of uniformity in practice in the actual placing of the fuse, in the following particulars:

a. Length of fuse for a given service.

b. Mass of the terminals used.

c. Position of fuse as to whether it be vertical or horizontal.

d. Environment, whether it be held in suspension, between terminals, or is allowed to lie along its entire length upon a mass of heat radiating material, and whether it be open to the air or inclosed in a chamber.

3. Deterioration caused by—

a. Recurring abnormal currents.

b. Oxidation from various causes.

c. Disintegration from local voltaic action.

4. Impairment of contact at terminals due to loosening of the clamps from temperature expansions and contractions, or to mechanical or electrical causes.

5. The "Peltier" effect.

6. The abuse of acceptable fusing devices, by substituting for the metals designed to be used in them others that are unsuitable.

7. Time element. Practice has demonstrated that fuses rarely, if ever, "blow" in time to accomplish the object for which they are placed in circuit. There is also a wide range of uncertainty as to the constancy of this period of time for any given fuse.

8. Capacity of the ordinary fuse wire to pass current far in excess of its rated blowing capacity for a period of time sufficient, in a majority of cases, to cause damage to some portion of the circuit.

We believe that a careful consideration of the phenomena noted in the foregoing will tend to convince even the most skeptical that, because of the great number and variety of peculiar and irremediable factors thus contributing to an undeniably faulty service, there can be no doubt that the common use of fuse wire cut-outs for the protection of electric circuits—be they lighting or power—in the present advanced state of the art, is not only totally inadequate and inefficient, but actually dangerous, because, in many instances, such practice is accepted as protection.

That the fuse wire cut-out as a protector is an absolute failure has been fully accepted by users of power, particularly those in the electric railway field, is evidenced by the evolution and almost universal adoption of the magnetic cut-out at the power station, and the use of heavy copper wire "fuses" in the local motor circuits of their cars, which heavy copper wires never blow, and are not expected to blow by anybody who gives the matter the least practical consideration.

The magnetic cut-out is commonly defined as a device which opens the circuit at a set strength of current. In the light of certain phenomena brought forth by experiments made by the writers, we believe that this is not a full and complete definition. In fact, we think it is misleading, as will be explained later in this paper.

Although the magnetic cut-out, evolved from vital necessity and remodeled and improved during the past ten years, is to-day a fairly good and efficient device under favoring circumstances, it is yet far behind the present state of the

1. Read before the National Electric Light association at the Washington convention, February 27, 28 and March 1, 1894.

art, as exemplified in other devices in the same field, and your attention is now called to certain of its imperfections.

The same general principle governs all the various forms produced by the several manufacturers respectively, and consists of—

First—A long throw knife-blade switch operated to open by a trip actuated by the armature of an electro-magnet.

Second—A device for preventing or for blowing out the arc formed at the switch jaws by the breaking of the circuit.

Practically, the principal point of difference between any two magnetic cut-outs of the present day is in the methods adopted for overcoming the destructive effect of the arc, and thus far two methods have been adopted for this purpose, either of which exhibits ingenuity in conception and care in production, but neither of which is efficient except to a minor degree.

These two methods may be described as

First—The auxiliary break method.

Second—Electro-magnetic blow-out method.

Of these two methods probably the balance of efficiency is in a slight degree in favor of the first named, as in order to blow out an arc you must have first established it, and once it exists, no matter how slight the exhibit, it is a fault which is cumulative in almost geometrical ratio.

The efficiency of the first named method is handicapped by the fact that the auxiliary "break" mechanism, commonly constructed with carbon contact plates and pencils, is fragile, easily and quickly destroyed by the action of "breaking" and, in the case of "breaking" on an abnormal current of great volume, such as would be occasioned by a heavy short circuit or ground, a quantity of insidious vicious gas of high conductive power is evolved, which may not only cause damage upon the circuit in which it occurs, but may often play havoc with innocent neighboring circuits on a switchboard.

Then, again, this auxiliary breaking circuit is not competent to carry its proportion of an abnormal current of any considerable volume, and the result is that, while there may be no positive arc at the main switch terminals, there is always, to a greater or less degree, a destructive heating effect at these terminals, which exhibits in a cumulative manner globules or teat-like projections of fused metal, which may gradually render the cut-out inoperative or, at least, impair its usefulness.

This phenomenon of the formation of globular or teat-like projections upon the extremities of the switch terminals is not, as is commonly understood, the result of an incipient arc, but is due to fusion, pure and simple.

By reason of the snail-like movement of the switch arm to "break" as compared with the almost incalculable rapidity of action of the current, the gradual reduction of carrying capacity, caused by the comparitively slow movement of the bridge from between the switch jaws, finally establishes such great resistance to flow of the current that the terminals—both bridge and switch plates—are actually melted, and globules of molten metal are often thrown off by the further movement of the switch arm.

Were the by-path formed by the auxiliary carbon terminals of sufficient conductivity, this phenomenon might not occur, but from the relative high resistance of the material composing this auxiliary circuit, this construction is impossible, for the reason that, to attain it, the cross-section of these by-path terminals would be so increased as to become impracticable. As a matter of fact, it has come under the observation of the writers that the bridge of the switch has been absolutely fused to the switch jaws by the passage of a current that evidently did its work too quickly for the tripping mechanism to operate to "open." It is probable this phenomenon was the result of one or two causes:

1. A quick "come and go" current of a volume immeasurably greater than that competent to saturate the magnetic circuit.

2. First, the passage of a current sufficient only to attract the armature to the field pole without tripping the switch to "break," and second, the passage of an abnormal current of sufficient volume to transfer the switch, while in this condition, into a welding machine.

This last named fault is one common to this type of cut-out, and while the result is not always a weld at the terminals, a common result is that while the armature is thus acted upon—first, by being drawn to its pole by a current not sufficient to "open;" and second, while being held in this position by a subsequent normal current a dangerous overload occurs; the switch remains intact, and damage occurs to the circuit.

Under the best of circumstances magnetic cut-outs of either of these two sub-types require the constant supervision of an expert, and almost constant attention if the service is such as to cause frequent operations. If fused globules or teats occur at the terminals, they have to be removed. If the armature is moved and held against the field pole without opening the switch, it must be replaced in its normal position if discovered in time. If the trigger trip catch has become so worn by continuous service as to refuse to hold the switch arm in place to complete circuit, it must be removed and repaired. If a carbon pencil is broken off or burned up, it must be replaced and adjusted, and if, in the burning up of the carbon pencil, the gas involved has caused damage to a neighboring circuit, this damage must be repaired.

Most of these phenomena occur because of the sluggish action of the switch to "break," and this is largely due to faulty construction. Primarily, the switch bar is thrown to "break" by the action of a spring, or by the action of gravity; the switch bar being held in place with the bridge in contact with the plates by the engagement of a trigger lug with a seer or catch.

The device operates as follows:

1. The passage of an abnormal current attracts the armature and trips the trigger.

2. The spring forces the switch arm to "break."

3. The weight of the switch bar carries it farther and breaks the auxiliary circuit.

These three operations collectively consume so much time as compared with the time needed by the current to reach a destructive stage, that often, before the switch bar has moved, the destructive effect has been accomplished. This time element is always constant, for the reason that the medium abnormal current at which the device is expected to open is generally of a volume to saturate the magnetic circuit, consequently the armature always moves at a constant speed. The spring also pushes the switch arm away at all times with a constant force and speed, and gravity, which completes the operation, is also constant.

Another factor of inefficiency in these types of cut-outs is the coarseness of adjustment to the current desired to open. While it is possible to give such a device a comparatively wide range of adjustment as between minimum and maximum load, the intermediate steps are not capable of fine and comprehensive adjustment, except by an expert, which renders the device unfit for anything but the coarsest work.

Then, again, the distance required between the switch jaws and between the auxiliary carbon plates, together with the distance required for the complete throw of the switch arm, all combined with the massiveness of parts which seems to be required in this form of cut-out, renders the device so cumbersome and withal so expensive, that its use is limited to a narrow field.

However, with all its faults, it has proved to be far in advance of the fuse cut-out as a protector to electric circuits from the fact that under favoring circumstances it may be counted on to perform a given service in a predetermined way, and there can be no doubt that the time is not far distant when this baby, now in its swaddling clothes, will have been pushed forward to robust maturity, capable in every respect of performing its allotted service automatically and perfectly under any and all conditions of the circuit in which it may be placed.

A magnetic cut-out, which would exhibit a long stride toward ultimate perfection, would be a switch operated to open by the direct action of a magnet upon the switch bar in such a manner as to cause the current itself to drive the bridge away from the switch plates, thus insuring the quickest possible response to an abnormal current.

The break at the switch terminals should be protected by a by-path or shunt across the switch terminals, composed of a fuse wire of a carrying capacity sufficient to carry the current for a period of time ample to allow the switch bridge to reach a point of safety, and of a fusing capacity that will cause it to "blow" instantly when the switch bridge has thus reached a point of safety.

The magnetic circuit should be so arranged that the point of saturation would be beyond the capabilities of the flux incident to the opening of the switch upon the passage of a current at which it might be set and expected to open. Consequently, when abnormal currents, in excess of that at which the switch was set to open, occurred, the result would be an acceleration of movement of the plunger up to the point of saturation, and the time element would thus be reduced to a minimum.

In this connection we deem it pertinent to offer a new definition for a magnetic cut-out. This definition is evolved from careful experiment, and may be stated as follows:

A magnetic cut-out is a device which, primarily, opens the circuit upon the passage of a current at which it may be set to open. Secondarily, it opens the circuit upon the passage of any current greater in volume than that at which it is set to open, and it thus opens the circuit when this full abnormal current is actually passing, no matter what its volume may be.

DISCUSSION.

MR. HAMMER: I have seen a number of magnetic cut-outs used on the other side of the water. A year ago Swinburne, making some of his high-tension experiments, had a small one in connection with his transformer—a simple thing, made by a man named Cunningham; two little fingers dipped into a quicksilver cup, with a weight controlled by an electro-magnet. As soon as the circuit is broken or overloaded this drops down and the two fingers come out of the quicksilver.

MR. WHITE: Ours is of the same type.

MR. ROBERTSON, Minneapolis: We are running quite a number of incandescent lights and on an alternating circuit, and we have had considerable trouble with the fuses blowing out or some accident to the machine, which might have been averted if the fuse had blown out. We have renewed the fuses each month whether they blew out or not; and I have been looking for a device in the nature of a magnetic cut-out which would do away with fuses. We found it at last, and I have been using a magnetic cut-out on our 500 volt power circuit and they have never failed to act in time to save a machine.

MR. SMITH: Fuses are the things that generally cause most trouble. If you put the fuses in as light as they should be, they are sure to give you trouble; slight over-loads, the effect of time, or the causes that Mr. Harrington gives uses them up. They are replaced several times and then the engineer comes and puts in a piece of copper. Our rule has been, when we start with work of that kind, to begin with the lightest fuse that will carry the load, and then run it long enough to satisfy ourselves that the work is all right, and we then take out every one of those fuses and put in a fuse that will thoroughly protect the smallest wire nearly up to the carrying capacity of the wire—the blowing capacity of the wire. We thereby eliminate a great deal of trouble which is caused by putting in fuses heavier than they should be. We find in the dynamo room that regularly changing them once a month is the best. Fuses will in time deteriorate, and a curious fact may be observed when the fuse gets a scale over it and is held together by the scale until it suddenly gives way and the load is thrown on the other machine and your machine breaks down. The magnetic cut-out would not save us from that always, but would likely do it nine times out of ten.

MR. BROPHY, Boston: I have seen this phenomenon in fuses that came from the factory. I have tested them and found they would become red hot before they would let go. Fuses are a broken reed on which to lean. Some years ago we had a disastrous fire which was laid, justly or unjustly, to the electric current. We do not know whether it belongs there or not. I never thought it did. In order to allay the feelings in the breasts of the people of Massachusetts, Boston particularly, a few of us advertised for highly protected fuses, which would prevent an abnormal current getting into any building, particularly on the low-tension wires, which are the most dangerous. We tested them all; and while nearly all of them were ready to combat with an abnormal flow of current, none of them would stop the sneaking current. The present method of classifying fuses is all wrong. The fuses may be put in a building for a ten or sixteen candle light and the lamps are changed to a thirty-two. Of course the same fuses do not serve.

MR. VAIL: Magnetic cut-outs on lighting circuits have been used frequently in the Schenectady works of the Edison company in the testing of dynamos, and can be adjusted very accurately. It appears to me that there must be a difference made between the cut-outs that can be used in a central station and the cut-outs in a private house or isolated plant. In regard to the action in the fuse to which Mr. Smith referred, it is due to oxidation. The fuse is made of soft metal and is usually placed under a binding screw of brass. The metals are different, and oxidation will in time result. The only way to prevent that, in my experience, is to have a hard metal end soldered on the fuse—such as a brass or copper tip on the fuse. If the fuse is put into position clean, it will be found that the hard metal will prevent the oxidation, and no difficulty will be experienced. Captain Brophy is undoubtedly correct in the statement he makes in regard to replacing small fuses by large fuses. We brought that to the attention of the Edison people some years ago, and I sent some inspectors to examine the central stations. I found a great many instances where circuits of six lights, which had been properly fused in the first instance, had been replaced by a fuse for thirty lights, or a ten-light circuit by a forty-light fuse.

MR. SMITH: The oxidation under the heads of the fuse is not what I am afraid of. The instances I referred to always take place in the body of the fuse. It is undoubtedly due to some oxidation, which makes the skin of the metal less destructible by the heat; but it is something new to me to hear that they come that way from the manufacturer. In regard to the replacing of fuses, I happen to know of one fire that was caused by the owner of the house himself. He had a three-light circuit which was controlled by a plug fuse, and blew out. He put in another three-light fuse, and that blew out. He put in a six-light fuse, and that blew out. He happened to have a forty-light fuse, which he put in, and he burned his house to the ground.

MR. HAMMER: I think a good deal of trouble might be obviated if a three-cornered file were run across the fuse. It makes a weak point and causes a tendency to blow out at once if there is an overload. I have done that, and it has taken care of the trouble nicely. Captain Brophy called attention to the sneaking current. I have never yet found a fuse or device that will open a telephone line in time to prevent the burning out of the little magnets in the telephone, provided the sneaking current is small enough.

MR. ORFORD, Boston: The man who substituted a forty-light fuse for a three-light fuse ought not to have had that fuse in his possession. I have been connected with electric lighting interests quite a number of years, and I do not know of a single instance that has come under my personal observation where the fire was caused by electric lighting wires. I know that if you take up the reports from the fire commissioners in the state of Massachusetts they will show you that there is no industry in that state which produces fewer fires than the electric lighting business. The capital invested in electric lighting in that state is a very handsome one, and we are exceedingly anxious to learn all we can about protecting electric lighting devices; at the same time I have never been in a place where I have seen such negligence as here represented to exist. I would like to visit some of these stations where they are burning such a large amount of coal, and the places where such bad wiring exists. I think there are very few such cases. Of course this fusing question has no relation to arc lighting; it is simply applied to incandescent and power service. Our method of fusing is to use the simple, ordinary fuse, which we buy in the market. We have magnetic cut-outs on some of our dynamos, but we use also a fuse and switchboard for each circuit, besides the magnetic cut-out to protect the dynamo. Every time we branch from the main we put in a fuse, and every time we put a converter up we put in a fuse. We find little trouble with them, except when we get to larger sizes. The capacity of a fuse is an unknown quantity.

MR. SMITH: To my knowledge, we have had only one fire that has been traced to electric lighting in twelve years, and that was due to criminal carelessness in the wiring. I have put in more than 25,000 lights, and have never had a fire occur from bad work. I gave the instance of the plug to show what was to be avoided.

Storage Batteries in Central Stations.[1]

MR. BRACKEN, New York: As one who has been associated with the storage battery interests in this country from its inception, I have been asked by a number of storage battery representatives to open this discussion with a few preliminary remarks. I understand to-day the subject will be confined to their use in central stations. I am afraid that most of the storage battery men will approach this subject with some degree of diffidence by reasonable scepticism that exists in the minds of a very large percentage of the central station men about storage batteries.

Peace now reigns over the storage battery interests in this country. The companies have come in under one flag and are united for a common interest so that you may purchase a storage battery to-day with the confidence that you are not going to be annoyed by threats of suits for infringement. You not only have the advantage of peace, but you also have the advantage of the experience which has been gained both in this country and in Europe by these companies. We had the representatives of several foreign companies here this summer and we got a great deal of useful information from them. It is also natural that you should desire a certain guarantee as to the cost of maintenance and efficiency of the batteries. As to the nature of the guarantees any persons desiring to install a storage battery plant in his station can readily satisfy himself as to the life of the plants. He can then guide himself by getting proper guarantees as to the cost of maintenance. I do not think there is any company asking a larger percentage than 10 per cent. for the cost of maintaining the battery. I have no doubt that experience will prove the cost of maintenance to be less.

P. G. SALOM: The question of the advisability of the use of storage batteries at the present time in central station plants is purely a commercial one. Will it pay? All of you agree that storage batteries are a desirable adjunct to have in central station practice, but you are deterred for two reasons: First, you do not know positively that the investment will show a decrease in operating expenses; and, second, you are still more uncertain as to the cost of maintenance of the plant after you have made the investment.

Now, in order to answer these questions intelligently, the first requisite in this or any other quantitative determination is to have a unit or standard. This unit or standard is the cost of producing a given quantity of electrical energy under certain normal and fixed conditions. In other words, given a standard engine and dynamo of the average size used in central stations, what is the cost per kilowatt hour or ampere hour? Having determined this cost, based on a given price for coal and labor, each central station operator can determine at the end of the year how closely he approximates this ideal cost by dividing his total output into his total operating expenses, and further by keeping careful records he can also determine what factor or factors are operating to prevent his attaining the ideal results. For example, if by reason of his geographical location his coal costs him twice as much as the price assumed in the original estimate, his operating expenses will be increased proportionally, and if they exceed this additional amount he must look to other factors to explain the increase.

Having determined all these factors for his own individual case it becomes a simple question of arithmetic for him to determine whether with an additional investment for a battery with a given output and efficiency and at a given cost for maintenance, he can advantageously add to his plant a storage battery. No hard and fast rule can be adopted. No two central stations are alike, either in equipment or output, and, therefore, the best size of battery equipment or proper proportion of battery to other units may never be exactly the same in any two cases.

Now, the second question may be briefly answered by the statement, that we are now prepared to give responsible guarantee that the maintenance of the battery shall not exceed a certain reasonable cost per annum, and which, of course, has been duly considered in estimating the additional cost and savings of a storage battery plant.

I. APPLETON: The Germantown Electric Light company has the distinction of being the first electric lighting company to use a storage battery equipment of American manufacture and design. The company had a day load of incandescent lamps and motors on the three wire system which was very unprofitable, and about 15 months ago they decided to try the use of a storage battery to see if the day load could not be made profitable instead of a dead loss.

A small battery was put in sufficient to carry the day load; its capacity was 800 ampere hours with a normal rate of discharge of 80 amperes. The machinery was then shut down from daylight till dusk, the battery taking care of the day load.

This being an experiment to ascertain the true facts about the working and value of a storage battery for central station purpose, very careful figures were kept and the result of the first years's working was eminently successful and resulted in a large saving. According to Mr. Allen, the superintendent of the station, the saving on the one year's running in labor, coal, water, oil, waste, etc., not counting the decreased depreciation of machinery due to shutting down from daylight to dusk, was $2,500. Besides this there was a great advantage in being able to overhaul and examine all machinery in the day time while everything was shut down.

This being so satisfactory and the behavior of the battery being equally good, the Germantown company decided to put in a battery of 2½ times this capacity which would enable it to increase the day load and consequently increase the savings, as the cost of charging a large battery is only the extra fuel required. This larger battery was installed at the beginning of this year and is the one which I will now describe.

The battery consists of 120 cells of the chloride type G, eleven plates in each, arranged 60 on each side of the three wire system. The capacity of each cell is 1,000 ampere hours, or 2,000 hours with both sides. The normal rate of discharge is 200 amperes, maximum 400, and this can safely be increased in case of sudden demand or emergency. The plates are protected by the improved asbestos insulation and are contained in lead lined wood tanks. An asphalt floor, well drained, is provided, so that there is no trouble in handling the acid. One special feature of these cells is the size of the plates, 15 inches square.

Any one who has had experience with storage battery will appreciate this point, and will readily understand how much less trouble and expense there is in the maintenance, when only eleven plates are required to give 1,000 ampere hours' capacity instead of about eighty plates.

Plates of the chloride type can be constructed larger than this without any difficulty, and give equally good results.

This battery plant has been designed to meet all the requirements of the three-wire system, and to give the greatest possible flexibility. The ordinary course of working in the Germantown station is as follows:

The machinery is shut down at daylight and the battery carries the whole of the day load till dusk, when the dynamos are started again. The battery is then switched out during the hours of heavy load, and started in again for charging when the load decreases.

By this means the general plant is working at an efficient load during all the hours it is running, and the extra fuel for charging the battery is hardly noticeable.

The daily routine is very simple; the discharge of the battery is noted by hourly readings, and at the end of the day the total discharge is ascertained.

A charge of about 10 per cent. in excess of the discharge is put in, and this is found to be sufficient. In some cases even less charge than this will bring the cells up to the proper electromotive force. Just before the end of the charge readings are taken in some of the cells with the hydrometer and voltmeter, and the condition of a cell can be accurately ascertained.

The maintenance of a storage battery is the point which frighten most engineers; in the old days 46, 50 and 60 per cent. efficiency was the average result and this, I believe, is the chief reason of the slow adoption of the batteries.

Until recently sufficient attention was not paid to designing the cells for the work they had to do. Engines and dynamos are designed and installed according to the nature of the work they have to perform, and this must be done with batteries.

Given a properly designed and installed battery, such as the one I have described, the maintenance and depreciation will not exceed that of the other portion of the central station plant. A storage battery does require attention, but not skilled attendance. The most important thing is to give it regular attention. Do not leave it for weeks or months till some fault develops, but treat it like other machinery, overhaul it regularly and prevent the occurrence of any fault.

A method I have found to be very good in looking after large battery plants, is to have voltmeter and hydrometer readings regularly, say once or twice a week, and every day overhaul thoroughly one cell, emptying out the acid, cleaning, if necessary, and putting everything in proper order. By doing this in the proper rotation every cell is examined, say twice a year, yet the time required is hardly noticed, being only an hour or so every day. In this way the efficiency of a battery can be kept high and results obtained which will put on very different complexion in some electric light stations.

There are many stations in this country which are running the day load at a loss, or are losing business by not supplying current at all in the day. To these stations a battery plant would be invaluable and would give a very different result when the balance sheet is taken off.

In many cases it would be best, of course, to leave the battery in the line always, and then when the general plant is running the battery acts as a regulator, taking up any fluctuation in the load, relieving the generating plant and keeping the potential constant.

Again, in some stations the load curve takes the form of a sharp peak for a short time during the evening, when most of the lights are in use. A battery will assist the dynamos during the period of maximum load and it removes the necessity of providing a generating plant which will only be used for a very short time during the 24 hours, standing idle and unprofitable the remainder.

There is another question, too, which electric light men have to face: How can we profitably reach the outlying districts with our direct current main? Here, again, the battery plant proves valuable; small sub-stations in the outlying districts can be built for the batteries, and these can be charged in series at say 400 or 500 volts and the current distributed at the required pressure.

MR. DECAMP: I happen to know something about the condition of the Germantown plant. The objection seems to be that they had an unprofitable day load that prevented them from making any money or as much money as they thought the station ought to earn. I think that came from the fact that before going into the day business the station had been fairly profitable. But looking into that matter one time for a friend of mine who was interested, I concluded that the loss of the day load was sufficiently absorbed by the profit on the profitable part of the business, and I so stated. I heard nothing more of it until the batteries were introduced, and I have been told by the company that that has stopped this loss. Now, I would like to know whether in the experience with the battery—because it is a small one, it takes up about the day load of the business, as I understand it—whether the use of the battery has done anything more than to save the loss which the station made while it was running an unprofitable day circuit; or, in other words, knowing what the profits or results of the station were previously to the introduction of the day business, have the real substantial results increased since the introduction of the batteries in proportion to the increase of their business, or whether it has simply been a saver of what they lost.

MR. NICHOLLS: I have a question that I think can be answered at the same time. Some of the gentlemen—one, at all events—referred to the Germantown station and set forth the great advantages gained by reason of the storage battery taking care of the day load; that previously it was necessary to run the dynamo to take care of that load, and, if I understood him correctly, it took about sixty amperes. As I understand it, that was an ideal case in which a storage battery could work to advantage. I am very much interested and have been giving a good deal of consideration to the storage battery question. We have quite a heavy day load. It would not pay us to run a day load with the storage batteries. The day load we run on the three-wire system, the same as we run our lights, with six hundred amperes. It will average at the present time all through the night, from twelve o'clock to seven o'clock in the morning about seven to eight hundred amperes. If we could have an accumulator to take care of that load, it would be an advantage to shut down our station and do with one shift of hands. My difficulties may be the same as the other gentlemen of the convention, and if any one interested can give us the information we require, it would be an advantage to us.

MR. WRIGHT: I am connected in a semi-official capacity with the Germantown Electric company. As you have been told, in December, 1892, that company adopted a chloride battery. The battery was not put in before we had thoroughly informed ourselves as to the amount we were losing from the operation of the day circuit. We made very careful tests. All the stations with which I am connected are conducted on the continuous day principle. We weigh the coal, measure the water, count the carbons, and we get it down just as fine as we can. We had the benefit of the continuous test at Germantown, supplemented by a test of two weeks duration which I made myself on the day circuit. I found that the amount paid for the day circuit was exactly the amount of our total loss by the entire incandescent business, which is composed almost half and half of direct current (220 volts) and alternating current (1,100 volts) distribution. You can readily see that amount of income from the day circuit should be added to that amount, and the loss from the day circuit should be the amount remaining. I am not at liberty to state this amount. But the year's experience showed a saving which has been stated as somewhere around $2,500, and that saving is only figured on the rougher items, and figured from my memory, as I did not have the exact particulars with me. There are some items, such as incandescent lamp renewals, which you can readily see would enter in, that were not included. The amount saved by the year's operation of the storage battery amounts to $700. The output was small. The average output on each side would be from thirty to forty amperes from dawn to dusk. I would say further that the amount of direct current distribution is just one-half the incandescent business of the station. There is one point about this battery that I ought to mention. At Germantown we have doubled the lamp capacity of our dynamos. The load figures for December showed us that if we were going to do as well this year as last year in the way of extension, we would have to look out and put in more direct current machinery, and in the annual estimate that was included.

MR. BARSTOW: What was the rate of interest figured on the investment?

MR. WRIGHT: When the old battery was put in only twenty-five per cent., or rather the depreciation was figured at twenty-five per cent., we allowing for that depreciation. The new battery earned about thirty-five per cent. on the amount of the investment during the year it was in operation.

MR. NICHOLLS: You say that it showed a depreciation of twenty-five per cent. in one year? Will you explain that?

MR. WRIGHT: I would rather not answer that question, and I may as well state the reason. Battery No. 1 was put in. It was a very small battery. I have said that the average load was about 40 amperes. The load at times during last summer, when we had motors, got over two hundred amperes, and that battery had to do the work. I cannot speak of the depreciation, for the reason that the battery was taken out, and the battery was not in as good shape as when it was put in. We could see evidence of the depreciation, but we have sufficient faith in the battery after one year's experience to put in a battery with two and a half times the capacity. We started with the smallest battery we could buy, but we could not limit our output. Our output consisted of motors for testing, and the current was "out of sight" as compared with the capacity of the battery. I considered that the conditions for the operation of that battery were adverse, and while it showed from a condition of depreciation when it was taken out, after a year's service, the evidence was sufficient to warrant us in sending for one having two and a half times the capacity.

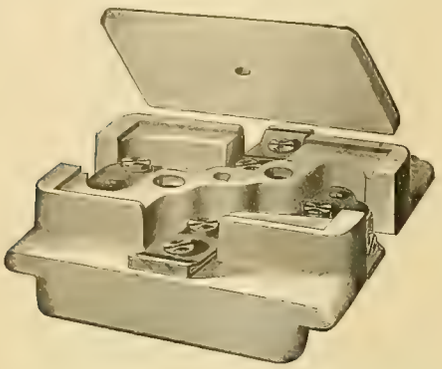
1. Discussion at the seventeenth convention of the National Electric Light association, Washington, D. C., February 28, 1894.

Apprehensive Parliamentarians.

In the British House of Commons a short time ago Mr. Weir, the member for Ross and Cromarty counties, in calling the attention of the president of the Board of Trade to the accident which occurred some time ago at Bournemouth, whereby one horse was killed and another injured, and which, according to Major Cardew's report, was due to the leakage of the electric mains laid below the street level, betrayed anxiety regarding the safety of "honorable members" in his inquiry as to whether such a fate was likely to befall them whilst in the precincts of "the House." Mr. Mundella was unable to reply to the question, and referred his interrogator to the first commissioner of works. Inasmuch as the low tension system is adopted at St. Stephen's, in which a pressure of 105 volts only is used, the gentleman's fears were groundless.

Cut-outs of the Bryant Electric Company.

The Bryant Electric company of Bridgeport, Conn, has recently placed upon the market a 500 volt covered cut-out and a covered Sawyer-Man main and branch cut outs. The covers are porcelain, and are designed with a view of both protecting the cut-outs from external injury and of acting as a safeguard in protecting outside

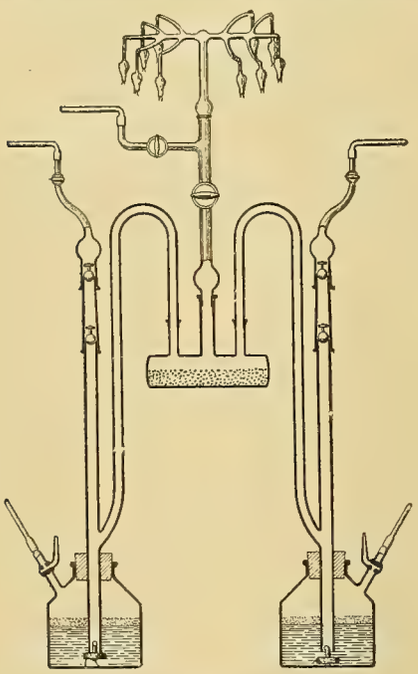


CUT-OUTS OF THE BRYANT ELECTRIC COMPANY.

objects from coming into dangerous contact with any portion of the cut-out which may be charged with electricity. The careful work and superior quality of materials which characterize the products of the Bryant Electric company are noticed in these specialties. The accompanying cut shows the covered Sawyer-Man branch cut-out. The western representatives of the company, Thomas G. Grier and Edward K. Grier, with offices and store room in the Monadnock building, Chicago, keep a full line of all goods in stock at all times.

Tubular Vacuum Pump.

The accompanying cut shows an improved type of mercurial vacuum pump for use in the manufacture of incandescent lamps. While the familiar Geissler principle is used, the pump differs essentially from the usual Geissler forms, and its principle can be briefly characterized by the word tubular. The utilization of this principle has enabled the inventors to produce a pump which is claimed to



TUBULAR VACUUM PUMP.

show a remarkable increase in capacity, with a resultant decrease in the expense of exhausting the lamp bulbs. It is asserted that one of the new pumps, using 45 pounds of mercury, has exhausted ten lamps to the highest degree in thirty minutes, while three hours were required to exhaust the same number of lamps by the usual Geissler forms. It is also stated that tests in actual practice indicate that the ratio of efficiency of the new tubular pump, compared with the usual Geissler forms, is about five to one in favor of the former, while much less space is required for the same capacity. The claim is also made that there is a decided gain in the quality of the lamps over those exhausted on pumps of the old form. Further information in relation to the apparatus can be obtained on R. P. Ashwell, of Newark, N. J.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 10.—The consolidation of the trolley interests of the Brooklyn Heights Railroad company, the Long Island Traction company and the Brooklyn City Railroad company was announced last month. In the future the companies will conduct their business with one staff of officers and probably under one head. The directors of the three roads met in executive session February 21st and perfected the organization. Although President Lewis and Secretary Bogardus resigned their offices in the Brooklyn City Railroad company at the meeting, their re-election is believed to be a foregone conclusion. The three companies will then be one corporation.

Rather than stand a criminal or civil prosecution for stealing water from the city, the officers of the Citizens' Electric Light company of Brooklyn have agreed to pay a fair price for the water which, it is charged, they have surreptitiously obtained. This case has attracted considerable attention and has resulted in a thorough investigation into the affairs of the company. A number of years ago the company obtained the consent of the proper authorities to run a 4-inch water pipe into its plant with the understanding that it was to be used only in case of fire. It developed recently that since that time the plant has been supplied with water from this connection without paying a cent to the city of Brooklyn. The company, it is thought, will have to refund something in the neighborhood of $20,000, but it is not likely that any prosecutions in connection with the irregularities.

At the monthly meeting of the Chamber of last Commerce action was taken upon the report of its special rapid transit committee, which was made at the meeting on February 15th. This report recommended that the city be authorized to lend its credit to the extent of two-thirds of the cost of the completed system of rapid transit, or about $30,000,000, to a corporation organized to construct a rapid transit system. This proposal was opposed by ex-mayor Hewitt and others, and the following amendment to the report was unanimously adopted:

Resolved, That in case the credit of the city is used, the ownership of the rapid transit system should be vested in the city, but its construction and operation should be intrusted to such responsible corporation now existing, or hereafter to be formed, as may, in addition to the interest on the city bonds, pay the largest annual rental, such excess to be used as a sinking fund to retire the bonds of the city, and when the bonds are so retired the lease to be terminated.

Resolved, That thereafter the lease should be sold to the highest bidder, upon such terms as may be prescribed by the city authorities, for periods not exceeding thirty years, in the same general manner as the ferries are now sold, with the stipulation that the successful bidder shall purchase from the previous lessee the rolling stock and other personal property at its fair valuation, to be determined by arbitration.

Resolved, That proper safeguards and conditions ought to be provided by appropriate legislation in reference to the issue of the city bonds and the construction and operation of the rapid transit system, under the general supervision of a board of engineers, so as to secure economy of cost and adequate accommodations for the public use, and that the committee be continued, with power to add to their number to confer and co-operate with the authorities of the city in reference to the general plan of the needed legislation.

Assemblyman Butts introduced a bill at Albany, March 1st, to repeal the law which created the rapid transit commission in New York city. The bill which Mr. Butts introduced makes no provision for successors to the present commissioners.

The rapid transit commission met on March 6th. A. L. Lauterbach renewed his proposition to purchase the franchise for the syndicate he represents. Nothing was accomplished at the meeting, and the feeling prevailed that Mr. Bushe's plan for elevated roads could not be favored by the commission. The following letter from R. T. Wilson & Co., the firm that planned the underground road to be operated electrically, was read:

In our letter of January 18th, submitting a proposition for the building of an underground system of rapid transit, we stated that it was not our desire or intention to do so unless it met with a hearty support of the people of New York. Since that time a plan has been presented by the Hon. A. S. Hewitt, which seems to meet with greater popular favor. We therefore withdraw our proposition in order that we may not obstruct or stand in the way of carrying out Mr. Hewitt's plan. We beg to say that it will give us much pleasure to lend our hearty support to Mr. Hewitt's or any other plan which will give the city the needed relief.

The plan referred to in the above letter is to build an underground electrically operated road upon the credit of the city, and operate it under municipal management.

W. F. O.

PERSONAL.

A. J. Farman, managar of the Iron Mountain, Mich., Electric Light company, was in Chicago on business for his company this week.

William J. Hammer of New York recently delivered an interesting lecture upon "Electricity" before the Dryden Literary and Musical Society. Mr. Hammer showed quite an elaborate series of experiments in electricity and magnetism, and the application of electricity to light, heat and sound. He was assisted by Francis Lawton and E. J. Cabot.

Among the lecturers for 1894 in the engineering department of the University of Wisconsin are the following named: Gilbert Wilkes, Detroit, Mich., "Dynamo Designing;" A. V. Abbott, chief engineer of the Chicago Telephone company, "The Evolution of the Telephone Switchboard;" Louis A. Ferguson, electrical engineer of the Chicago Edison company, "Modern Electric Light Stations;" Prof. A. J. Rogers, Milwaukee, Wis., "Electrolysis;" Elisha Gray, Highland Park, Ill., "The Telautograph."

NEW INCORPORATIONS.

Wisconsin Automatic Light company, Chicago; capital stock, $100,000.

Spearfish Electric Light & Power company, Chicago; capital stock, $50,000.

ELECTRIC LIGHTING.

The municipal authorities of Deva and Kolozsvár, two important towns in Transylvania, have decided to introduce electric lighting.

The contract for placing the wires owned by Minneapolis, Minn., underground, has been let to the lowest bidder, Tobin & Gleason, and work will be commenced at once.

An application has been made by a company to the board of trustees of Charlotte, N. Y., for a franchise to furnish electric lights and construct water works in the village.

Arrangements have been completed under which the plant of the Mutual Electric Illuminating company of Westfield, Mass., will come under the control of the Westfield Gas company.

The proprietors of the Oshkosh, Wis., Electric Light company have notified the city that hereafter the work contracted for by the company cannot be done for less than $75 per arc light per annum. The original price was $52.

The Palmyra, N. Y., Electric Light company has been organized with a paid up capital stock of $10,000. The following named gentlemen were elected directors for the ensuing year: B. H. Davis, C. C. Hunt, George Tinklepaugh, Samuel P. Nichols of Palmyra, and W. J. Morrison of Syracuse, N. Y.

The city of Minneapolis has won the suit brought to set aside the five-year contract with the electric companies for street lighting. This suit was to pave the way to municipal ownership. The suit was commenced by Joseph L. Kücsli, president of the city council, against the city and the Brush company to procure the cancellation of the five-year contract that was made in August, 1892, between the city and the company for city lighting. It was heard before three judges, Hicks, Smith and Elliott, who, March 6th, filed an opinion declaring the contract off and fully sustaining the position taken by the city attorney.

S. M. Hamill, the general manager of the Brush Electric company of Cleveland, O., about two years ago purchased for his company the plant of the gas company of Rock Island and also that of the electric light company. C. H. Deere, S. S. Davis and others of Moline controlled the gas and electric light companies of that city. The Moline people ran their mains and wires into Rock Island to compete with the local companies, which retaliated. This led into some severe competition and complications, which have finally resulted in the formation of a new company, the Peoples' Power company, which purchased from Mr. Hamill the property held in his name, and that of the Moline companies. The Peoples' Power company is erecting a large new electric light station on the water power located between Moline and Rock Island. The electric light stations in Rock Island and Moline will be abandoned and all their good apparatus removed to the new station. They have recently purchased a large amount of new electric lighting apparatus from the Brush company. New gas works will be erected near the new electric light station and the old gas plants abandoned. Plans have also been made for the distributing of the power that the two cities will need. The city of Moline, which has owned its own electric light plant for a number of years, found that it was a poor investment and that the lights were costing it more per year than they would if a contract were made with the local company. The city, therefore, sold the electric light plant to the new company and has made a two years' contract with it. The history of these transactions is interesting because it is a forcible illustration of the fallacy of municipal ownership of electric lighting plants and because it is an instance of the consolidation and concentration of electric light and gas properties in one plant and under one management.

ELECTRIC RAILWAYS.

The Sandusky, O., Milan & Norwalk Electric Railway company has decided to conduct an express business.

Work is to be begun at once on the Manchester, Mo., electric railway. The power house will be located at Benton.

All the employes of the electric railways at Youngstown, O., struck March 4th, because of the discharge of

the engineer of the power house, who refused to accept a reduction in wages.

The new electric line of the Neville Island & Coraopolis, Pa., Railway company will be put in running order about March 1st. The road will be almost 14 miles long, 9 of which was built at a cost of about $100,000.

Considerable opposition to the trolley car bridge, which it was proposed to build across the Niagara river over the gorge at a point near the existing upper suspension bridge, has been encountered and in all probability the idea will be dropped.

A petition has been sent to Mayor Stuart of Philadelphia, asking him to allow a hearing before he signs an ordinance providing for the occupation of certain streets for the construction of an elevated railroad by the Market Street, Richmond & Frankford Electric Railway company.

President J. N. Beckley, of the Rochester, N. Y., Railway company, has issued an order, reducing by 10 per cent. the wages of all employes. The order affects the salaries of the officers and heads of departments, as well as the rest. The cause is the depression in business, which offsets traffic on the lines and reduces receipts. The business on the lines has been dropping off, and the cut in wages was not entirely a surprise.

An ordinance was passed in the Chicago council on February 26th which gives the North Chicago Electric Railroad company the right to construct and operate an electric road on Milwaukee avenue, between Armitage and Lawrence avenues, and on Lincoln avenue, between Wrightwood avenue and North 59th street. An effort was made to add an amendment which provided for the use of the underground trolley or storage batteries, but it was not accepted by the council.

ELECTRIC MINING.

The operation of mining machinery by electricity appears to be making certain progress on the Pacific coast. An instance is that of the Tomlin mine in Madera county, Cal., where it is proposed to transmit power from a station three miles distant, the power being supplied by a 200 horse power Pelton wheel. The mill is at a considerable elevation, and it is necessary to raise water about 800 feet to supply the mill. This will also be done by electricity.

It is reported that one of the most complete electric installations of mining machinery in the country is soon to be made at Butte, Mont. It is understood that the plans contemplate the purchase of five electric hoists, nine electric pumps, both for station and sinking purposes, and electric drills. In fact, steam power will not be used around the mines for any purpose. A mammoth smelter will be erected near the site of the Butte reduction works, and this will also be operated by electric motors, and the electrolytic process of treating the ore will be adopted. To furnish the current for the mines and smelter the company will install its own dynamos to furnish the motive power. Electric cars will convey the ore from the mines to the smelters, and the handling of the ore by elevators will also be accomplished by the use of electricity.

POWER TRANSMISSION.

The municipal authorities of Cornwall, Ont., are considering the feasibility of running their factories by electrical power derived from the Long Sault dam. If the proposition goes through, it is said that an electric railway service and connections with the Canadian Pacific railway will follow.

A contract has just been made by the United Electric company for a large plant to transmit power from Indian Orchard to Springfield, Mass. The generator is to be of 400 horse power. Its weight is 25 000 pounds. In addition to the generator a 350 horse power transformer will be set up at the main station.

The Anniston, Ala., Cordage company operates its mill entirely by electrical power. Current is obtained from an electric railway company. This is believed to be the first mill operated entirely by electricity. The installation of motors for power purposes in mills has been going on for some years, but the substitution of a motor or motors in place of shafting to drive mules and looms has not been largely accomplished.

The Pawtucket, R. I., Gas company is paying much attention to the development of the supplying of electric power from its electric annex. The company is now setting three more 150 horse power boilers of the type furnished by the Bigelow company of New Haven. The company is supplying electric power for the running of 28 railway cars in Providence, and from Providence to Pawtucket, with eight cars in Pawtucket and vicinity. It is also supplying current for general power purposes in Pawtucket, equivalent to 100 horse power per day, the motors running from one to 30 horse power.

LEGAL DECISIONS.

An employe having knowledge of danger about him, the Supreme Court of Appeals of West Virginia says, must use prudence and care to protect himself from harm; and if he willfully and imprudently encounters such danger, his employer is, generally, not responsible for the injury caused thereby.

In the case of the Postal Telegraph Cable company against Adams the Supreme Court of Mississippi held that a state privilege tax of a certain sum per mile of wires operated within the state, imposed on all telegraph companies therein operating, in lieu of all other state, county and municipal taxes, and amounting to much less than the sum of a single ad valorem property tax, is not an interference with the interstate commerce of a foreign corporation.

In the case of the Industrial & Mining Guarantee company against the Electrical supply company in the sixth circuit of the court of appeals, the question of a mechanci's lien on electric lighting plants was the point of contention. The court held that materials furnished for the construction of an electric lighting apparatus, railway and power house are not within the provision of the general lien law of Ohio, giving a right to a lien for machinery or materials furnished for "erecting, repairing or removing a house * * * or other structure."

For the owner of a patent to charge that an article made by another manufacturer infringes his patent is not necessarily unlawful; and for him to give notice of an alleged infringement may, the Supreme Court of Indiana holds, in the case of Shoemaker against the South Bend Spark Arrester company, if given in good faith, be a considerate and kind act on the part of the owner of the patent. But if the owner of a patent, instead of resorting to the courts to obtain redress for alleged infringements of his patent, threatens all who deal in the goods of a competitor, as the owner of another patent, with suits for infringement, thereby intimidating such customers from dealing with such competitor and destroying his competitor's business, such acts of intimidation will fall within the preventive reach of a court of equity, and an injunction may be obtained, even in a state court, to prevent a continuance of the intimidation.

Great difficulty has always been found, the Supreme Court of the United States holds, in applying the rule that the profits of an infringer afford a standard whereby to estimate the amount of damages recoverable from him and in defining the extent and limitations to which this rule is admittedly subject. But it now sums the matter up thus: It is competent for a complainant who has established the validity of his patent and proved an infringement to demand, in equity, an account of the profits actually realized by the infringer from his use of the patented device; that the burden of proof is on the complainant; that where the infringed device is a portion only of the infringer's machine, which embraces inventions covered by patents other than that for the infringement of which the suit is brought, in the absence of proof to show how much of that profit is due to such other patents and how much is a manufacturer's profit the complainant is entitled to nominal damages only.

An electric railway company which has provided its cars with gates to prevent passengers from alighting on the side next to a parallel track cannot defend itself against the charge of negligence in not keeping one of the gates closed, by the evidence of its president "as to observations he had made in reference to electric street car lines, cable car lines, and other street car lines operating on double tracks, that he had made recently in various cities of the United States in reference to the use of gates on the cars, and to show that gates are not used." So holds the Supreme Court of Georgia in the case of the Augusta Railway company against Glover. It is further said, in this case, that there may be no negligence whatever in failing to have gates, for the very highest order of equipment may be dispensed with, provided the equipment is sufficient to come up to the standard of extraordinary diligence. This standard may be reached short of the very best or the superlative of the attainable. But, when a company has provided gates, due diligence might require it to use them, and failure to use them might be negligence in the given instance.

In the action brought to recover damages from an electric street railway company for the death of a passenger, sustained in alighting, the Supreme Court of Georgia, in the case of the Augusta Railway company against Glover, holds that it is competent to show that he had no previous experience in traveling upon an electric car, for the purpose, at least, of illustrating the cause of his failure to alight from the car in safety. The jury, it is said, in looking at the facts and circumstances of the homicide, would naturally desire to classify the particular passenger, not alone by his age, but also by his experience, or the want of it, in handling himself as a passenger on electric cars. Familiarity with this mode of traveling would qualify him to see and appreciate danger which he would not be likely to observe if he were wholly without experience. With experience he might be chargeable with fault; without it, with none. And hence, in the one case his failure to come off safely might be attributable to his own negligence, in part or in whole, whereas, in the other case, he might be treated as free from any negligence whatever.

Several interesting decisions have been made in the prominent case of the Edison Electric Light company against the Mt. Morris Electric Light company in the Circuit Court of Appeals, Second Circuit. One is regarding an injunction to restrain infringement of a patent, and provides that persons who establish a plant for the use of infringing electric lamps pending a suit to vest the validity of the patent, which is brought and pressed with reasonable diligence, have no equities to prevent an injunction because the patentee delayed suing them until the patent was sustained in the test suit. In the second decision it washeld that the fact that an infringing user of an electric lamp necessary to the operation of its plant has made great expenditures looking to future extensions of its business is no ground for refusing to enjoin it from going into new territory and buildings, or from continuing to light buildings which it lighted after the patent was sustained by the Circuit Court in a test case, and the great pecuniary loss which the infringer would suffer by an unqualified injunction only gives it an equity to be allowed to use the patented lamp, for a reasonable compensation, in the buildings it had lighted prior to the test suit. An abstract of the third decision is as follows: An equity to be supplied with electric lamps by the manufacturing patent owner, at reasonable rates, may arise in favor of one who, pending a suit to test the patent, and while foreign claims thereon were conflicting, has purchased from an infringing manufacturer an expensive plant, requiring the lamp for its operation; but this equity does not apply as between an exclusive licensee for a given territory, who has expended large sums on the faith of the patent, and an infringer, who has invaded such territory, pending the test suit.

TELEGRAPH.

Theodore Reid, an electrical expert of London, England, has been employed by English capitalists to go over the proposed British cable route from Australia to British North America. This route, as at present outlined, is from New Caledonia via Fiji, Samoa, Fanning Island and Honolulu to Vancouver. In discussing the proposed route, Mr. Reid said that no serious difficulties were presented in the laying of the new cable, but what it was desired to ascertain at present was the probable cost of the enterprise from an electrical point of view.

A dispatch from the City of Mexico states that a syndicate of Mexican and American capitalists has been organized for the purpose of constructing a pan-American telegraph line to extend along the Pacific coast from Victoria, B. C., to Chile, passing through the United States, Mexico, the Central American states and the Pacific coast countries of South America. The promoters of the enterprise have applied to the Mexican government for a concession for the proposed line through that country, and it is said that it will probably be granted.

The overhead telegraph system of the Paris department, and particularly the lines of l'Ouest, from the center of Bordeaux to Lyons, are reported to have suffered considerably from the storms which passed over France towards the end of the month of December. A large number of the lines have been interrupted, and some of the posts have been blown down. These disturbances tend to emphasize the importance of the movement of establishing underground telegraph lines between Paris and the large towns. The annoyance caused has been considerable.

TELEPHONE.

The Congo company contemplates the building of a telegraph line from Boma, over Matadi, Leopoldville and Stanley Falls to the Tanganyika Lake. The total distance is about 4 800 miles, and the completion of the whole line will occupy several years. The Boma-Kenge section is expected to be finished during 1894-95.

The minister of posts and telegraphs, Rome, has under consideration a scheme for an important extension of the telephone system of the country. It is proposed to establish trunk lines between Turin, Milan and Genoa; between Florence, Pisa and Leghorn; and between Rome and Naples.

Capitalists of Southampton, L. I., have organized a stock company for the purpose of constructing and operating a telephone system on Long Island. The company will be known as the Long Island Telephone company. The lines are to run from New York to Montauk Point and Orient Point. Among the names of the trustees appear those of Carrie H. Bishop, Laura E. Van Brunt, Jennie Wicks and Carrie L. Corwith, all of Southampton.

The storm which raged in the East last month caused a great deal of suffering among the linemen who were forced to face it in order to keep the lines in working condition. About the most uncomfortable experience of the storm is reported from New Jersey. Two men were working on the telephone circuits near Plainfield, and became nearly exhausted from the labor and exposure. One of the men, in attempting to climb a pole, fell half unconscious upon the ice covered wires and cables and swung helpless in this position for a long time, until relieved by a companion. He was half frozen and was resuscitated with difficulty.

Asbury Park, N. J., has more than 100 subscribers to the New York & New Jersey Telephone company, nearly all of whom have applied by petition to the company for a uniform reduction to $50 a year for the service, and have threatened, in case of their request being denied, to have their telephones removed. It is intended to forward their petition to the general manager with the request that long-distance instruments be substituted for those at present in use. Several years ago the company made a fixed price of $50 a year for the service, and gave subscribers the privilege of telephoning to any part of the county without extra charge. Subsequently the price was advanced to $75 for the old style telephones and $100 for long-distance instruments, with extra charges for all out-of-town points.

TRADE NEWS.

The Clayton Air Compressor works, New York, have removed their offices and salesrooms to the Havemeyer building, No. 26 Cortlandt street.

The Metropolitan Electric company, Chicago, is getting in a stock of porcelain floor tubing of all sizes, to meet the requirements of the Board of Underwriters. The Xentric switch, handled by the company, is not as generally known as some other switches on the market, but where it has been introduced, it is found by practical men to possess much merit. It is the latest improved device in switches, and is made by H. T. Paiste.

The Racine Hardware company, Racine, Wis., has purchased the plant and personal property of the Racine Hardware Manufacturing company, and is now ready to carry on a business in those articles previously handled by the defunct company. Particular attention is called to the fact that the company is making something of a specialty of

the Racine automatic steam engines. This type of machine is well known to the trade and will be extensively exploited by the new company.

The illustrated price list, No. 1, issued by N. S. Large & Son, manufacturers of electrical supplies, 321 Chestnut street, Philadelphia, is exactly what its term implies. Opposite the pages upon which are shown the switches manufactured by this company, are the price lists for the various sizes. The instruments manufactured by Large & Son are of superior design and present a neat and pleasing appearance, as well as being made to stand all the exactions made upon them.

J. Holt Gates, western manager for the Waddell-Entz company's directly connected dynamos and motors and copper-zinc storage battery, has become western contractor for the belted railway and lighting generators and motors of the Mather Electric company of Manchester, Conn. Mr. Gates had been agent of the Mather Electric company only one day, when he sold two 500 light dynamos. Mr. Gates proposes to do a general electrical contracting business. Mr. Gate's headquarters are at 1139 and 1140 Monadnock building, Chicago.

The Bryant Electric company, Bridgeport, Conn., has issued a little folder calling attention to its specialties and its larger catalogue "which has a red cover." The Bryant double-pole switches were used throughout the World's Fair, and their durability and capacity were established satisfactorily. The Bryant–Cleveland arc light cut-out is illustrated in the folder. It is quick, sure and positive in its action, and is made entirely of incombustible material. The other attachments and cut-outs of the company receive their due share of attention.

Among recent shipments and orders of the Ball Engine company, Erie, Pa., are the following made to public buildings in different parts of the country: Two 100 horse power engines, to the Criminal Court building, Chicago; one 100 horse power engine to the House of Correction, Chicago; one 60 horse power engine to the Illinois State Reformatory, Pontiac, Ill.; one 100 horse power engine to the Industrial Home for the Blind, Chicago; two 100 horse power engines to the State Asylum for Chronic Insane, Wernersville, Pa., and one 135 horse power engine to the Willard State Hospital, Willard, N. Y.

It is an evidence of the merit of the metal sheathed bushings handled by the Central Electric company, that the article is endorsed by the underwriters requirements, and it is a proof of its popularity, that the company holds the record of having sold over 30,000 bushings in one day. This bushing is thoroughly waterproof, non-combustible, and has superior insulating qualities. The armor with which it is provided gives it strength and durability. It has a small external diameter, and requires a much smaller hole than those substances which are mostly used. The large head prevents breaking or splitting, and the smooth brass armor makes the bushing easily driven into position. The addition of this speciality to the stock of the Central Electric company has been a valuable one.

C. E. Woodruff & Co., 235 Lake street, Chicago, dealers in telephone, telegraph, electric light wires and electrical supplies and apparatus generally, have been pushing the sale of the A. C. L. flexible conduit with considerable success lately. This conduit has no sleeves, joints or elbows and possesses many advantages for insulating protecting wires. Another specialty the firm is pushing is a new canvas covered lamp cord, for which it has placed numerous orders. C. E. Woodruff & Co., are general western agents for the Callaghan Fire Hose company, the Globe Rubber company and the Bradford Belting company.

Edward M. Bentley, formerly the inventor and engineer of the Bentley-Knight Electric Railway company, who has been for the past four years and a half in charge of the patent department of the Thomson-Houston Electric company and the General Electric company, severed his connection with the latter company on March 1st, and has opened an office at 40 Water street, Boston, taking up the work of expert in patent cases and solicitor of patents. The law firm of Bentley & Blodgett, with which Mr. Bentley, who is a member of the bar as well as an expert, has been connected, will be dissolved, and his former partner, G. R. Blodgett, will succeed him as head of the patent department of the General Electric company, making his headquarters at Schenectady.

C. I. Hague, treasurer of the New Haven Insulated Wire company, New Haven, Conn., reports that his company is making a special feature of its line of fan motors and small slow speed motors for power purposes. The fan motors are wound for 110, 220 and 500 volts, and may be used upon arc light circuits. They make 720 revolutions a minute, exhausting 7,500 cubic feet of air a minute, and on a 110 volt circuit only use one and one-half amperes. They require little attention after being set up. The small motor handled by the company are all of slow speed, are economical in the consumption of current, and are designed to be used upon all lighting circuits. They are self lubricating, and seem to have met with much favor. More than 400 have been sold this year by the New Haven Insulated Wire company, and there is every indication that the demand will more than meet the supply.

The introduction of the Packard transformer has met with such success that the Electric Appliance company, Chicago, as the western selling agent, has found it necessary, in order to meet the demands of the trade, to carry a large stock in the Chicago store. Several large shipments have already been received and more are on the way. The Electric Appliance company is now prepared to ship all ordinary orders from Chicago stock without a moments delay. The increase in the demand for electrical porcelain goods has been very marked of late, particularly since the underwriters and electrical inspection departments in nearly all of the large cities are demanding the use of porcelain cleats, insulators and tubes in place of the same article in wood or rubber. Anticipating somewhat the increased demand for these goods, the Electric Appliance company has largely increased its porcelain line and is prepared to furnish from stock, porcelain insulators, cleats and window tubes in almost any quantity.

M. M. Hayden, for six years connected with the Law Telephone company, and who was president and manager of the Law Battery company, resigned his position last month to embark in a new and much wider field. His long connection with the Law Telephone company as manager and projector of the battery department, taught Mr. Hayden the value of combining the factory and sales department in the handling of galvanic cells and supplies and he has found an excellent opportunity to turn his knowledge to account by assuming the management of the Hayden-Booker Manufacturing company of St. Louis, Mo. This company was organized as a manufacturing concern. It makes carbons, zincs, covers and jars, and in this way sells direct to customers, avoiding the immediate sales which make such supplies expensive. The company will manufacture the following cells: Hayden carbon porous cup Nos. 1 and 2 cell, Leclanche clay porous cup cell, Standard Fuller and No. 2 cell, single cylinder carbon and double cylinder carbon cell. The company's location in the central portion of the country will enable it to keep in touch with the trade and effect a great saving in freight, and under the management of Mr. Hayden it will doubtless meet with success.

BUSINESS.

The Mather Electric company of Manchester, Conn., has appointed S. N. Blake of Elmira, N. Y., contractor for the Mather apparatus in Northern and Western New York.

The Babcock & Wilcox company announces the removal of its main offices to 29 Cortlandt street, New York, and is sending to the trade folders illustrating its eleven branch offices.

The Meriam & Morgan Paraffine company, Cleveland, is placing on the market a new insulating compound called Paragon pitch, which seems to be meeting with favor among users.

The Bryant Electric company, Bridgeport, Conn., has placed a cut-out on the market that is striking for its neatness and ingenuity. A 220 or 500 volt current cannot send an arc across its terminals, neither can it be short-circuited by any canopy or shell of fixtures. For street car wiring it will be of particular value, and in other uses it will without doubt be popular.

W. L. Fairchild, 521 Kirk building, Syracuse, N. Y., has been appointed electrical engineer for the city of Jamestown, N. Y., which is to increase its electrical plant at a cost of over $30,000. Mr. Fairchild has also been called upon to act as consulting electrical engineer for D. McCarthy & Co., of Syracuse, who are to install an electric light plant in a large block which they are now building.

The offices of the Whitney Electrical Instrument company have been removed to Penacook, N. H., where the United States factory of the firm is located. The following is a list of the officers of the company: President, Hon. D. B. Varney; vice-president, F. T. Dunlap; secretary, O. B. Green; electrician and general manager, Dr. A. H. Hoyt; financial manager, E. R. Whitney; general selling agent, Henry F. Kellogg.

The Central Electric company, Chicago, reports an increased demand for the new iron armored interior conduit which has been brought out to meet the requirements of a high grade of construction. Its first order was given by G. W. Furbeck, 1161 Monadnock building, who will use it for the wiring of the new West Side tunnel. The presence of a large amount of moisture renders the use of a high insulating medium imperative, and this new type of conduit is designed to meet all of the exacting requirements.

Charles E. Gregory, of the Charles E. Gregory company, Chicago, is an example of an energetic Chicago hustler. Not satisfied with the business obtained during the Washington meeting, on his way home he made the circuit to Newark, N. J., and bought the small trifle of twenty Westinghouse "trader" machines aggregating in capacity about 4,200 lights. Mr. Gregory also sold on this same trip to the Richter Electric company of Camden, N. J., a 50 arc light plant. A visit to Mr. Gregory's commodious Chicago establishment reveals the fact that he is in a position to supply almost everything that could be desired in the line of motors, dynamos and other electrical appurtenances "that have seen some use." He carries an extensive stock and is always in line to do business.

It was a matter of a great deal of regret on the part of many of the Washington convention delegates that Presiden William H. McKinlock, of the Metropolitan Electric company of Chicago, was unable to attend. It was expected until the last moment that Mr. McKinlock would do so, but inquiries since the meeting have developed the fact that he has just returned from a business trip, and although he was desirous of going to Washington, he could not have done so without great inconvenience. However, although the head of this thriving new concern could not be present he had an able representative, at least as far as P. & B. products were concerned, in Frank S. DeRonde. Mr. McKinock states that the Metropolitan incandescent lamp is meeting with great success in the western market; and it is most reasonable to presume that under his progressive policy this branch of the Metropolitan company's business will be one of its features. The Metropolitan company's new quarters are well calculated to fill the needs of a rapidly increasing trade.

ELECTRICAL PATENTS.

Issued March 6, 1894.

515,751. Electric Switch Signal. Thomas L. Dalton and Nelson W. Dalton, Sandy Hill, N. Y.

515,755. Electric Motor. Gano S. Dunn, New York, N. Y.

515,761. System for Signaling and Communication. Thomas F. Gaynor, Louisville, Ky.

515,762. Electric Signal Box. Thomas F. Gaynor, Louisville, Ky.

515,775. Apparatus for Forming Sheds in Looms Electrically. Joseph Kauffmann, Hanover, Germany.

515,778. Electrical Metal Working. Herman Lemp, Lynn, Mass.

The invention consists essentially in including the two pieces to be welded in the path of electric energy and connecting the work between the terminals with an intermediate point of the divided source, and adjusting the relative potential of the two sides or portions of the source according to the conductivity of the pieces to be joined.

515,797. Telephone Receiver. Charles Selden, Baltimore, Md.

Two or more electro-magnets are properly combined to act in conjunction for producing sound impulses, whereby a tendency is produced of tiding or bridging over the effects produced by sharp or sudden impulses.

515,779. Strain Insulator. Henry H. Luscomb, Hartford, Conn.

515,805. Employes' Time Recorder. Nelson M. Watson, Detroit, Mich.

515,806. Electric Lighting System. Harvey J. Wells, Osceola Mills, Pa.

515,822. Electric Cable. Thomas J. Dewees, Palmyra, N. J.

515,827. Water Alarm for Boilers. Charles A. Hatch, Hartford, Conn.

515,845. Telegraph Repeater. William E. Sloan, Chicago, Ill.

515,850. Electric Arc Lamp. James J. Wood, Fort Wayne, Ind.

The invention consists of the combination in an arc lamp for constant potential circuits of the main and shunt magnets, the armature and the armature lever, loosely connected to the armature, so that the armature moves beyond the lever of circuit-closing contacts in the shunt circuit, arranged to be normally separated when the magnets are inert, and one of them connected to the armature to be closed against the other by the initial movement of the armature relatively to the armature lever under the attraction of the main magnet, whereby so long as the main magnet is excited the shunt magnet is retained in circuit, and upon the extinguishing of the arc the shunt magnet is open-circuited.

515,882. Dynamo-electric Machine. James E. Maynadier, Taunton, Mass.

515,885. Electrical Transmission of Power. Charles F. Scott, Pittsburg, Pa.

515,900. Alternating Current Motor. Charles E. L. Brown, Baden, Switzerland.

515,927. Hanger for Trolley Wires. George Forbus, Williamsport, Pa.

515,939. Telephone Exchange System. Edwin Pope, Quebec, Can.

The invention entirely dispenses with the use of spring-jacks, and substitutes therefore plain contact points in the circuit.

515,960. Automatic Cut-out for Incandescent Lamps. Edward H. Johnson, New York, N. Y.

515,962. Alternating Current Motor. John F. Kelly, Pittsfield, Mass.

515,967. Street Car Sign. Edgar J. Rauch and Wilfred A. Keith, Brockton, Mass.

515,969. Regulating Socket for Electrical Apparatus. Elias E. Ries, Baltimore, Md.

515,970. Electric Current Regulator. Elias E. Ries, Baltimore, Md.

The invention applies particularly to incandescent electric lamps, and provides a device housed in the socket or holder for regulating the current to the translating device by variations of the external resistance of the same.

515,971. Portable Regulator for Electric Currents. Elias E. Ries, Baltimore, Md.

515,977. Alternate Current Motor. William Stanley, Jr., John F. Kelly and Cummings C. Chesney, Pittsfield, Mass.

515,994. Apparatus for the Preservation of Corpses. Victor E. Cohen, Philadelphia, Pa.

516,038. Automatic Switch for Storage Battery Use. Theodore A. Willard, Norwalk, O.

516,079. Process of Making Incandescent Elements. Theron C. Crawford, New Brighton, and Ludwig K. Böhm, New York, N. Y.

516,080. Composition for Incandescent Elements. Theron C. Crawford, New Brighton, and Ludwig K. Böhm, New York, N. Y.

516,170. Armature for Dynamo-electric Machine. Montgomery Waddell and Justus B. Entz, Bridgeport, Conn.

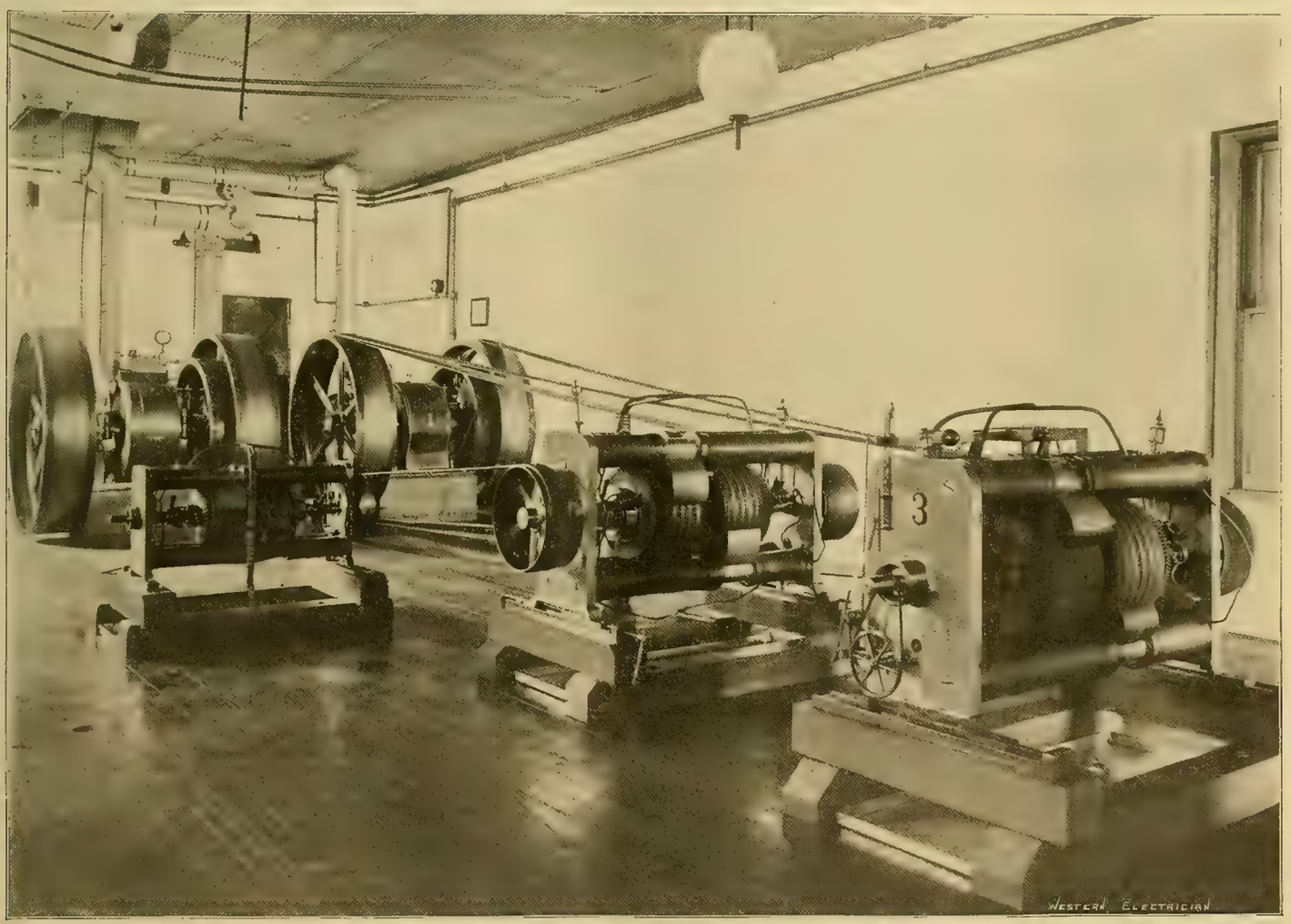
Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, MARCH 24, 1894. No. 12

Plant of the West Chicago Light & Power Company.

The multiplication of small central station plants in Chicago has been in proportion to the city's growth, especially in those comparatively new portions toward which the population is drifting, for it in time becomes impracticable for the older companies to farther extend their mains, and a new field is opened for the investment of private capital. These stations, lying in the outskirts, as a class, usually contain interesting machinery, which is frequently of a kind not found in the plants nearer the center of the city. Such a station is that of the West Chicago Light & Power company, located upon West Madison street, near Rockwell street. The home of the company, which is the successor of the Stiger-Newhall Electric Light company, is in a conveniently arranged and roomy two-story brick building, constructed especially for the plant, and located practically in the center of the territory which the company lights. This territory comprises Madison street from Paulina street to Kedzie avenue, Lake street from Paulina street to Campbell avenue, Western avenue from Lake street to Thirteenth street, Twelfth street from Western avenue to Leavitt street, Ogden avenue from Twelfth street to Jackson boulevard, and Van Buren street from Ogden avenue to Western avenue. It will be seen that the ground covered by the company is extensive, and, as the cables are entirely underground, that the work of construction was considerable. The illustration upon this page shows a view of the dynamo room, containing four dynamos and two engines. The work done by the company is entirely arc lighting, and the direct current Ball machine is used exclusively, making it the only central station of this type in Chicago. The four machines are usually belt driven by two New York simple, automatic safety engines, one 12 by 13 inches, of 100 horse power, and the other 12 by 12 inches, of 80 horse power capacity; but at the present time only the larger engine is in service. From one of its fly-wheels is driven a 45 light machine, and from the other a 65 light machine driven tandem in connection with another arc dynamo of the same capacity, from the shaft of which a 30 lighter is belt driven. Although the rated capacity of the plant is only 205, 1,200 candle power arc lamps, the load about the first of the year was over 225, which was carried without difficulty.



DYNAMO ROOM OF THE WEST CHICAGO LIGHT AND POWER COMPANY'S PLANT.

The dynamos are of the ordinary Ball type, with wrought iron end frames, bars and poles. Two armatures are mounted upon each shaft, each armature raising the tension one-half of the full machine. This construction is adopted so that there is but one-half of the tension on the armature that there is in the usual style, and it is therefore subjected to but one-half of the electrical strain. One of the particular advantages claimed for this type of machine is that by taking a given weight of copper wire and spreading it over two cores as is done, instead of over one core, the iron of each armature is brought much nearer the pole pieces than is possible, with single armature machines, and the average distance of the copper wire from the poles is much less; hence, a greater proportional output is claimed from the Ball than from single armature machines. The mechanical regulating device manufactured by the Ball Electric Light company has been placed upon some of the dynamos, and has been operating in a very satisfactory manner.

The switchboard, which is not shown in the accompanying illustration, is somewhat different from those generally in service for arc lighting practice. It is not built upon the skeleton plan, but is of marbleized slate, four by seven feet, with a 12 inch shelf at the base for testing instruments. It is provided with the Ball type of current measuring instruments and plug switches of a special design for controlling six circuits. The boiler room is located in the rear of the dynamo room and contains two 100 horse power steel tubular boilers, manufactured by the Pennsylvania Iron Works, Erie, Pa. These boilers are designed with a special view to economy, the hot air and smoke passing under the boilers, back through the flues to the front of the boiler and then over the boiler to the steel and brick stack, 83 feet in height and five feet in diameter. A 300 horse power Berryman feed-water heater is in use, and a 300 horse power Wheeler & Tappan duplex pump furnishes water to the boilers. The mains of the company, as stated, are all underground, and are mostly laid in iron pipe conduits with manholes at each street corner. Lead cables lead from the streets into the building and separate conduits run from the dynamos to the switchboard. The arc lamps used in the lighting are of the Ball pattern. Upon the second floor of the building is a workshop and store room, which is also used as a testing room at times. It is well equipped for this purpose, containing among other tools a two horse power engine for turning a lathe. The excellent service given by the company is the best guaranty of the efficient and reliable working of the system.

Underground Work in Rochester, N. Y.

By George A. Redman.

In September, 1892, the Rochester Gas & Electric company entered into a contract with the city of Rochester to build a conduit, not only for the needs of the company, but also to rent to other companies for telegraph, street railway and electric light work. On State street and on East Main street, from State street to East avenue, eighteen ducts were placed on each side of the street. On South St. Paul street, North St. Paul street, Exchange street and Main street, east of East avenue, and west of State street, ten ducts were put down on each side of the street. The ducts are 3¼ inch vitrified pipe, made square with beveled corners, Fig. 1. The ends are also beveled on the inside. The tile was manufactured by the Standard Sewer Pipe company of Rochester, with the exception of a few car loads furnished by Camp & Thompson of Akron, O. It is burned very hard, and is of a dark brown color. The conduit comprises 228,000 pieces of pipe, each eighteen inches long, and 6,000 feet of three-inch iron pipe. The latter is laid across river bridges and areas above boilers, etc. The conduit has a total length of 25,000 feet, and is laid on an average of two feet from the curb, at a depth of four feet and eight inches. It was laid at the depth mentioned as a protection from heavy teaming. The pipe was laid in the same manner as brick with break joints, on a bed of concrete four inches thick and covered top and sides to a depth of four inches with concrete, as shown in Fig. 1. Crossovers were put in at all prominent street corners, with an average of ten ducts in each.

The manholes, Fig. 2, average five feet and four inches by five feet and four inches and six feet deep. Four were put in with dimensions of ten by ten by seven feet. The manholes were put in at each street corner, and where the distance was over four hundred feet, an extra manhole was put in between the streets. In addition to the manholes in the main business portion of the city, subsidiaries, shown in Fig. 3, were built on an average of forty-four feet apart, three feet and two inches by three feet and two inches and at a depth to take in the top row of ducts. There are 144 manholes and 112 subsidiaries. The manholes are ventilated by three-inch stand pipes, and are drained into the public sewer by a six-inch pipe.

The Edison tube system, Fig. 3, is laid on top of the conduit, and every other coupling box is either in a subsidiary or a manhole as shown in the cuts, making it very easy to make surface connections or test for trouble. Details of junction boxes are shown in Fig. 4. Three ten-feeder catch boxes are placed in the large manholes. The generating stations—two operated by water power and one by steam—and one sub-station for distribution. Connected with its system are 1,250 arc lamps (400 of low tension on Edison mains), 24,780 incandescent lamps, and motors representing 782 horse power. The water-wheels employed have a capacity of 3,150 horse power, while the engines are rated at 2,850 horse power. Within the last three months the company has removed about thirty miles of overhead wires from Main and State streets—the principal business thoroughfares of Rochester.

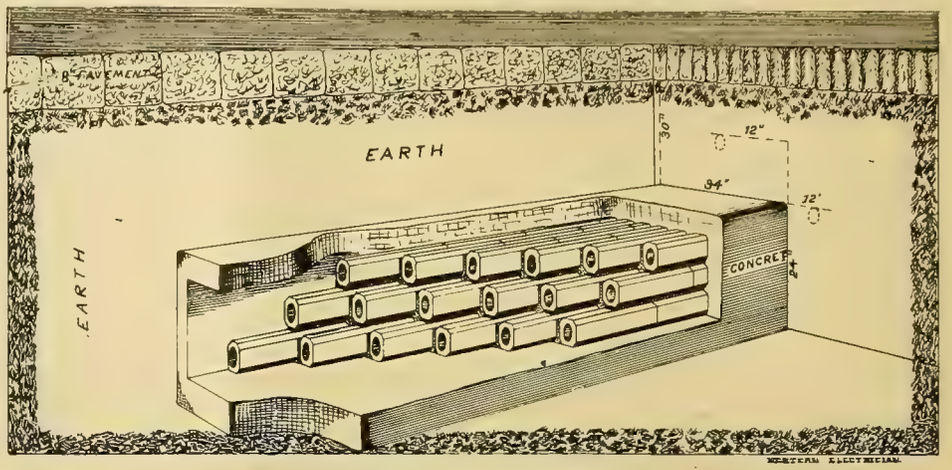


FIG. 1. UNDERGROUND WORK IN ROCHESTER, N. Y.

The Brush Electric Light company is using four miles of ducts and has drawn into the conduit thus far seven miles of No. 6 lead covered cable for arc lighting and two miles of No. 0000 cable for power circuits. The Brush company's cables are taken from the manholes through pipes under the sidewalks and up stand pipes attached to the front of the building, to porcelain cut-out boxes and distributed from there to the customer. This company has in circuit 1,495 arc lamps, 110 Bernstein incandescent lamps and 800 horse power in motors. Its station is situated at the Lower Genesee Falls, and is run by 15 double 15 inch turbines of 4,860 horse power.

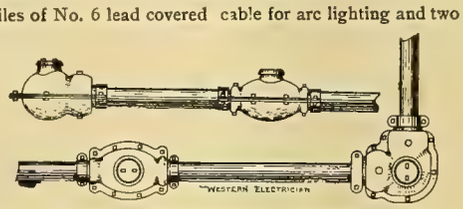


FIG. 4. UNDERGROUND WORK IN ROCHESTER, N. Y.

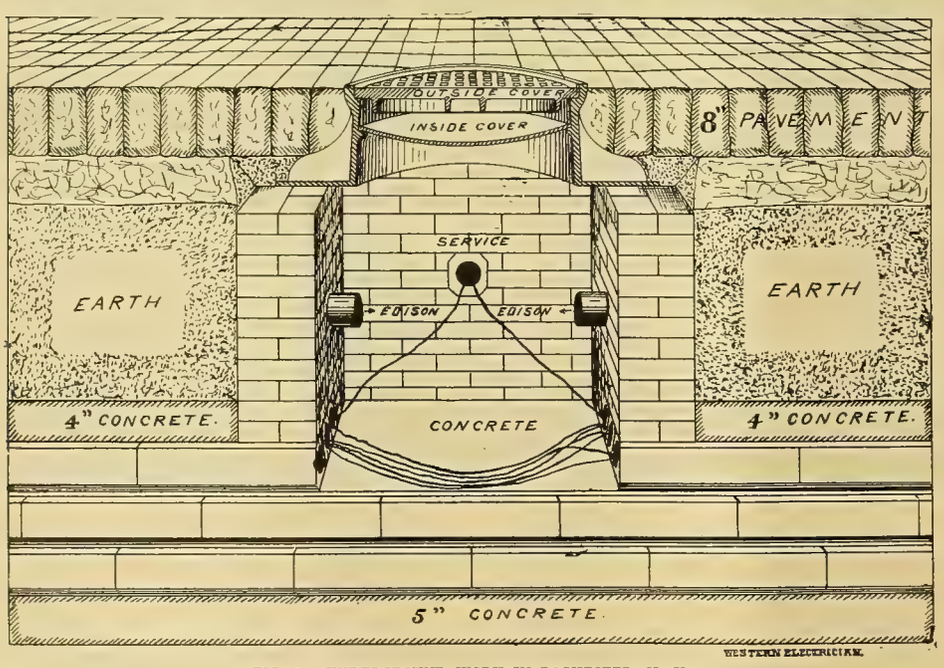


FIG. 3. UNDERGROUND WORK IN ROCHESTER, N. Y.

company has drawn into the conduit six feeders of between 500,000 and 600,000 circular mils capacity and is preparing to put in one 1,000,000 circular mils of feeder cable. For this purpose the Siemens lead and asphalt covered cable is used. The company has no high tension or alternating circuits in the conduit territory. In constructing the conduit it became necessary to move gas and water pipes; in two instances several hundred feet of ten inch gas pipe was moved three feet. The trenching and filling in was done by the gas department and the remainder of the work by the electrical department.

The streets in the underground territory are to be lighted with low tension eight ampere lamps from the Edison system, with one pair of lamps at each street corner. Iron posts 18 feet high, similar to those used on Fifth avenue, New York, will be used.

Elkader, Ia., is considering the advisability of introducing electric lighting in the village.

The Rochester Gas & Electric company now has threedu

Meters vs. Flat Rates.[1]

Frederic Nicholls: My opinion is that most central stations charging flat rates are doing so not by choice but by force of circumstances. Companies that have commenced business on that basis have not been able to change without a loss of customers by reason of competition. In my experience nearly all companies supplying current on the flat rate principle are not furnishing lamps renewals free. In that case you will find that in nine cases out of ten the customer will purchase a low efficiency lamp, and consequently the central station manager is furnishing from twenty-five to fifty per cent. more current than would be furnished if he had the right to say what kind of a lamp should be used. I know a company that I was called upon to advise with not long since, using low efficiency lamps and carrying customers on the flat rate principle that were furnishing 33⅓ per cent. more current than that which would have given the name unit of illumination if the company controlled the renewals of the lamps.

In the meter system of course there is more or less conflict with customers as to the amount of current used. In this connection I wish to call attention to the fact that there is a bill pending before the Canadian Parliament providing for the appointment of government inspectors of meters who shall have power to settle any question between the company and the consumer as to the amount of current used. It is provided in such cases that the meter be examined, and if it is found to be in good working order the customer pays the cost of the inspection, and if the meter is out of order the company will be required to pay.

Mr. Scott. I think it is only proper where a large quantity of water is used continuously or even occasionally that it should be measured, and the same rule would seem to apply to electricity. I think in dwellings it is good to have a meter, but I think it is more satisfactory to have a flat rate for stores. We know the hours required for lighting, and we know the number of lamps necessary, and I have found that the merchant is usually satisfied with a fixed charge whereby he can gauge his running expenses. In small stores using one, two or three lights, I would not allow a meter to be used. The difference between the best meter rate and the amount usually willing to be allowed on contract would make a depreciation on your income. We have on our incandescent circuit 365 contract lights and 1,817 meter lights. The contract lights last year netted us very much more than the meter lights.

Mr. Burleigh: I am operating two stations; one of them was formerly operated on the flat rate. We are changing that entirely to a meter rate, and in making that change we have cut down our output almost one-half without materially decreasing our revenue. I believe it is the only plan; there is no other fair plan, whether for a small customer or a large consumer.

Mr. Carnes: We have tried both plans, and we have recently made a rule that we will not put in a light except by a meter. I will give you one point to show how it worked with us. We had all we could do to carry what light we had to furnish. We have a station capacity of 7,500 lights, carrying 15,000 lights. With the meter system we are now able to serve our customers with perfect satisfaction.

Mr. Johns of Cleveland: We have recently introduced the meter system in Cleveland. We have one hotel from which we were deriving a revenue of $175 on the flat rate monthly, and from meter readings the bill was $1,100 at 16 cents a thousand watts.

Mr. Weeks: I think no matter what the commodity is we have to sell, the only fair basis on which to sell it, both for the producer and the purchaser, is a meter basis. I think the flat rate was one of the fundamental errors made in the electric light business at the outset. When our station was installed, it being the first of the kind in the world, there were no meters, and for some time we hesitated and refused to install the incandescent light for that reason. We finally, under presssure, installed the incandescent system without service meters, with the reservation that just as soon as a meter could be found we would have the right to install it. Upon that basis we undertook to give our customers a lamp for every gas jet, basing our charges upon their gas bills of the previous year. We finally got a meter, and we found thatafter we adopted the meter system that we reduced our output 50 per cent. and increased our revenue.

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1. Discussion at the National Electric Light association convention, Washington, D. C., February 28, 1894.

The Mutual Interests of Electricity and Fire Departments.[1]

By George P. Low.

Those features of the use of electricity which are of concern to firemen may be summarized, in general, as follows:

First—Electricity as a fire producer.

Second—Electrical appliances as an interference with the duties of firemen in combating fires.

Third—Electric light and power stations, telephone and telegraph offices and fires therein.

Fourth—Impairment of water mains and endangering sources of water supply by electrolysis.

Fifth—Electricity in the fire department service.

Considering these features collectively, there is no reason for doubting the broad assertion that the hazards to life and property from the manifold applications of electricity are over-balanced a hundred fold in the single boon that is conferred in the fire alarm telegraph. If electricity, uncontrolled, has cost millions of dollars and human lives by the score, no mortal can enumerate the billions in property or the thousands of lives that electricity, controlled, has saved through averting wide-spread conflagration. Let us then be magnanimous in judging the characteristics of this marvelous energy, for it is by far a greater friend than foe.

Broadly speaking, every fire caused by electricity may be properly attributed to improper workmanship or to indifferent care, from which arise several potent hazards. Water is as liable to cause fire from improperly constructed electric circuits as it is with quick lime. Every possibility of moisture reaching electric wires or apparatus must, therefore, be provided against, and it is for this reason that rules for safe wiring so often contain such clauses as "located in a dry place," "provided with a waterproof covering," "kept free from moisture," etc. The overloading of a circuit, that is, the crowding upon it of a greater current than it should carry, is not so prolific a cause of fires in incandescent lighting circuits as is generally supposed, principally for the reason that through the use of safety devices serious overloading has become an extremely rare occurrence. Moreover, overloaded circuits do not give satisfactory light, which prevents their being frequently placed. Again, in arc lighting the volume of current carried is so slight that the smallest size wire used in electric lighting will safely carry it without material heating. It will appear singular that the arc current, despite this comparatively small heating ability, produces more known fires than any other form of circuit. The cause for this apparent anomaly is that arc lighting circuits are operated at high electric pressures, which are difficult to restrict; that their insulating covering suffers deterioration from exposure to the weather, and that they are almost universally carried in and out of buildings through or around awnings and cornices. They are, therefore, easily interfered with, and their proper maintenance necessitates constant watchfulness. Arc lamps are nothing more and nothing less than open flame, which sometimes throw off glowing sparks of carbon dust, white hot flakes of carbon or red hot globules of molten copper. Treat them accordingly. Keep ignitable material from around and under them and the lamps themselves will be rendered safe from fire.

The crossing of arc, trolley or other aerial wires with telephone or telegraph wires, etc., produces heating in the delicate telephone or telegraph instruments that not only chars them badly, but frequently causes fires. The best cure for this class of fires rests in the use of strong current protectors.

These general observations briefly set forth the most potent features in the use of electricity that constitute fire producers. The subject is so exhaustless and has been treated so fully in the series of papers read by myself before the Fire Underwriters' association of the Pacific, and entitled "The Fire Hazards of Electricity," that further discussion would be redundant.

A most serious phase of the electrical problem is the manner in which the erection of the pole lines of aerial wires interferes with the duties of firemen. The interference is dual in its nature. It is physical in that the wires present an actual barrier, which must be overcome with force, and it is moral in that the men are naturally fearful of the consequences of handling circuits, the character of which they do not understand. No one need hesitate to cut telephone, telegraph or other signal wires, for if you receive several shocks they will only startle you. No one need expect to be killed electrically if he cuts a trolley wire or a whole set of railway feeder wires. If you stand on a ladder of dry wood that is not metal bound, and if it is not raining and you have no connection with the earth through metal or moisture, you may hack away at the trolley wire with perfect impunity. In fact, the trolley alone is as harmless as the car rail, for the trolley forms one pole of the dynamo and the car rail forms the other. So long as either one is touched alone it is without danger. But should you, by any means, through dampness or metal, become connected with the earth while handling a trolley wire, you would receive a shock that might double you up, or it might be so light that ample consolation would be had in mild profanity. Of this, however, you may feel assured; if you are robust, no shock you may receive from a trolley circuit will, of itself, kill. It might knock a man from a ladder and the fall might prove fatal, or if a man had heart disease, he might not survive, but I have never known of an instance where the so-called "deadly trolley" has of itself proved deadly.

With arc lighting and alternating current wires, both of which are operated at high pressure, it becomes a matter of great hazard for a layman to cut them, particularly if wet. It is advisable that they should be handled only by an experienced lineman. Such wires are dangerously "hot," not only with each other, but each with the earth.

With reference to fires occurring in electric light and power stations and in telephone and telegraph offices, I beg you to most carefully consider the fact that water is almost, if not quite, as fatal to most forms of electrical apparatus as is fire, and that, therefore, in combating fires in such premises the utmost discretion must be used in throwing water. The necessity for this is all the greater for the reason that the stream of water may take any high electric potential and carry it to the nozzleman with possibly fatal results. A fire that occurred in an electric light station in a large eastern city several months ago entailed a loss of about sixteen thousand dollars, of which amount only a few hundred dollars was lost by the fire itself and the remainder was due to the wetting of electrical equipment, which caused the current it carried to consume it. The use of a garden hose for five minutes in the main operating room of any large telephone office would entail a loss running into tens of thousands, and telegraph offices, though not equipped with such expensive apparatus, are almost equally sensitive to water. I would strongly advise that water should never be used except as a last resort, and even then, if possible, it should be with the sanction of the station superintendent who will at least indicate the locations of those wires or apparatus carrying electric pressures that may prove fatal. Above all, fire chiefs should familiarize themselves with such stations as are in their jurisdiction and should ascertain from those familiar with electricity those portions of the installations that are most costly and most sensitive to both fire and water. You may thus acquire that discretion which it is necessary that you must evince in handling fires in this supersensitive form of apparatus.

A new feature of concern that will, sooner or later, force itself upon those in your calling is the possible destruction of water mains and all underground metal work from the use of electric railway circuits having a ground return. This destruction, which is due to the action technically known as electrolysis, consists in the corrosion of water mains which have, perforce, become conductors of the electric railway current. A remedy of the evil may be had in converting the circuit from a "grounded" one into a metallic one, or, to be more plain, to run return wires to the power house instead of allowing the current to return through the rails, the earth and underground metal work or piping.

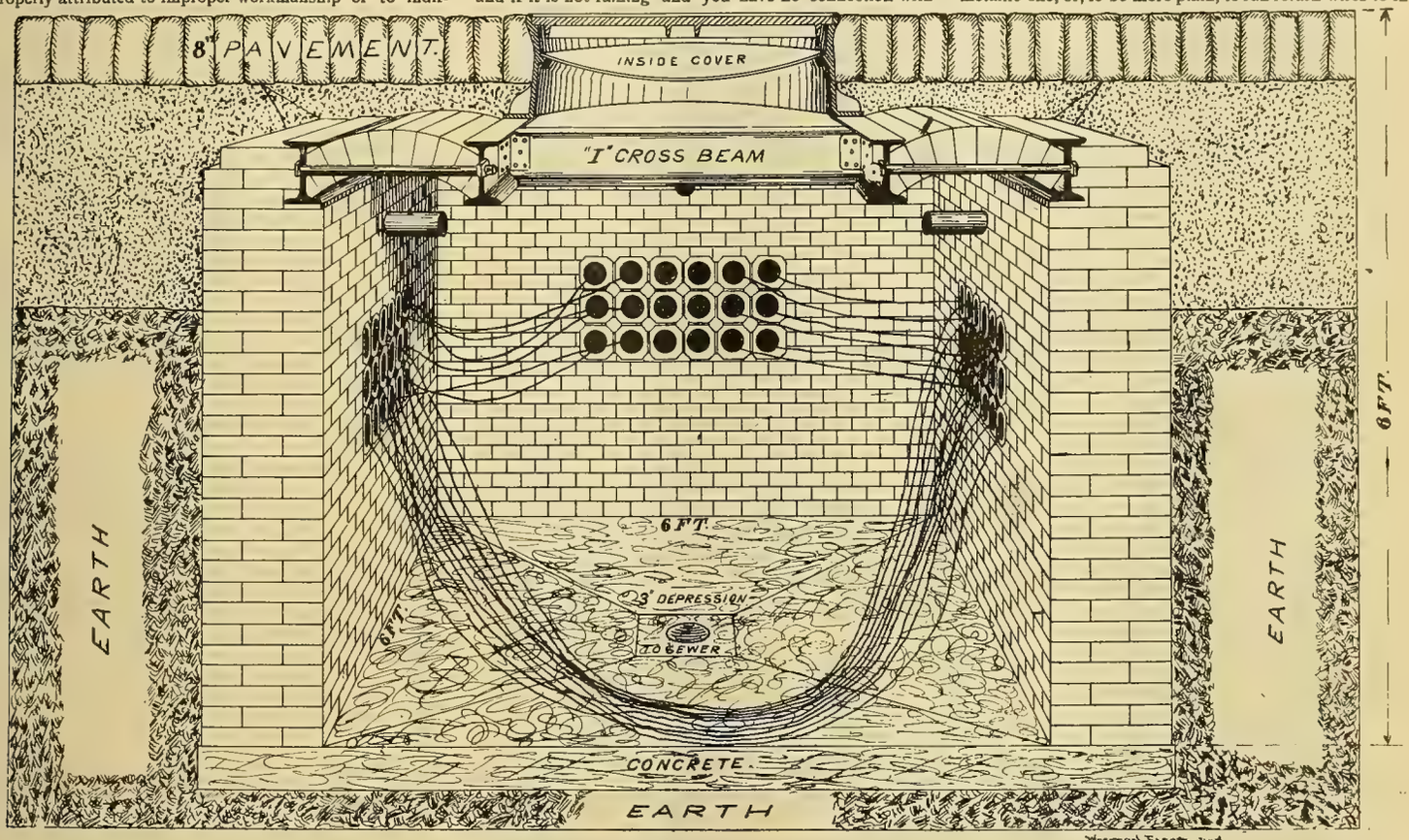


FIG. 2. UNDERGROUND WORK IN ROCHESTER, N. Y.

The fifth and last feature of the applications of electricity worthy of your consideration is its use in fire department service. Fire alarm systems are, I understand, to receive special attention from one well qualified to discuss them, but I would feel remiss did I not offer a word in reference thereto. Your earliest experience with electricity came through the use of the fire alarm telegraph. It quickly ingratiated itself into your esteem and you soon found it to be indispensable. But, beyond this, in the automatic fire alarm there is presented a system that not only is impossible of failure, but which automatically discovers the fire and rings in an alarm therefor with absolute reliability. The perfection which automatic fire alarms have attained is marvelous, and the benefits accruing therefrom are so immeasurable that every exertion and reasonable concession should be made to secure its introduction and use. Among other things the rules of the Pacific Insurance Union for the installation of automatic fire alarm service require that the system shall be able to transmit an alarm of fire under any circumstance, even if the line wire is broken. If the system gets out of order from any cause it must give ample warning thereto and yet ring in automatically a faithful alarm for any fire that may occur. It must, moreover, invariably thwart malicious interference by any layman, and call attention to the fact of such attempted interference. These stipulations are not only required but they are actually carried out. Such a system is more than human. Man may perceive and act, but he is mortal and may fail. As the breath of life was breathed into the form of clay, so is the unfailing mechanism of the automatic fire alarm telegraph endowed with the marvelous force of electricity. Nature's most subtle energy courses through its veins, and sleepless, tireless, unfailing it ever guards its vigil, for the laws of nature never change.

1. Read at the third convention of the Pacific Coast Association of Fire Chiefs, San Francisco.

Latest Coin Controlled Automaton.

The "automatic electric saleslady," which is illustrated in the accompanying view, is the latest novelty in the vending machine line. It is intended principally for an advertising medium, and each machine will vend a variety of small one, five or 10 cent articles. The case is six feet high, six feet long and two feet six inches wide, and has glass panels in which to place advertising matter. The machinery to operate the mechanism is placed underneath the counter, and is driven by a ⅛ horse power electric motor. Placed on the counter are the directions, with a row of push buttons, and opposite each button is the name of the article it represents with the price.

In its right hand the figure holds a tray with a slot in it, and when the customer drops in his coin, the motor is set

LATEST COIN CONTROLLED AUTOMATON.

in motion and the arm swings to the left. In passing over a hole in the counter, with a slide underneath which opens and shuts at the proper time, the coin is dropped and the tray, reaching a spout in the side panel, stops for a moment in order to give the coin time to operate the inside mechanism for delivering the desired purchase. The left arm then raises a slide, the article dropping into the tray, which then swings back to the starting point and stops. The push buttons cannot be operated before a coin is inserted, and should a person insert a coin of a lower denomination than that specified opposite the button he presses, the figure will go through the movements without delivering any article. The machine never makes a mistake in delivery if the proper coin is inserted. Electric lights are arranged to light it for night service. Patents are pending upon the device, which is the invention of R. H. Little, engineer and electrician of Sinai Temple, Chicago.

Work of the Electrical Inspection Department in Chicago.

In view of the multiplication of electrical devices and the almost universal adoption of electric lighting and power for new buildings as they are erected and for many of the old ones, there is no question of more vital importance for the consideration of the heads of municipalities and the fire underwriters than that of the hazards of electric wiring. The question has been given commensurate attention in many localities, as the seriousness of the problem made itself apparent, and in a number of the large cities capable departments have been established for the proper inspection and restriction of the risks. Within the last few years the insurance men have come to look upon the subject of electrical wiring as one of the most perplexing and uncertain of risks, and, as far as possible, they have adopted measures for their own protection. In the larger cities of the country they have looked to the local government for protection, and Chicago, in accordance with the demand and in common with other cities, established an electrical inspection department under municipal control. In consideration of the many obstacles which have hampered the work of this department, its work has been well done and of the utmost value. Perhaps there is no other city in the United States where a more efficient and thoroughly equipped department of this character is needed than in Chicago. The erection of buildings and the extension of the territory has been enormous in the last few years, and, in proportion to this activity, has the work of the inspectors been increased, yet although the rates of the underwriters are being raised wherever electric hazard exists, and, although the number of fires assigned to electrical causes show an increase, the expansion of this department seems to have been restricted, and at the present time the working force consists of but one chief inspector and five assistants, who are expected to cover the vast amount of territory called Chicago. The management of the inspection department lately passed from the hands of Col. J. J. Wilson, who has been its head, under Chief Barrett, ever since its inception, and to whose efforts most of the success of the department is due, to the care of Chief Inspector E. F. Norton. Mr. Norton has made it his task to broaden the character of his work and to enlarge the usefulness of the service. The growth of the city makes such a step an imperative necessity, and every insurance company, every property owner and every electrical engineer and supply man should unite in attracting attention to the needs and importance of the department. The number of inspectors is too small, and the time is approaching when an electrical laboratory for the testing of instruments, wires, etc., will be an absolute necessity. Were this accomplished the department would be in a condition to render an inspection service that would cover the ground completely and be second to none in the country. The following statement is made by W. H. Merrill, Jr., electrician of the Chicago Fire Underwriters Association, who is in an excellent position to judge of the needs of the department:

The effort Chief Inspector Norton is making to extend and systematize the work of the city electrical inspection department is most commendable. Such a department as he aims to establish would be greatly beneficial, not alone to the electrical interests but to the entire community. With the new rules which Superintendent Barrett has adopted the work of the men is necessarily increased. Bringing about the general enforcement of these rules will mean no little labor. It would seem that all of the fees collected should be spent in carrying on this work and that the department should be provided with a working force and with appliances commensurate with the task it is expected to carry out. The number of defective electrical equipments in the city show the need of a system of competent, thorough and rigid inspection and re-inspection. The efforts being made by the city to increase the efficiency of the electrical department and to cover the wide territory under its jurisdiction should receive the support of every one interested in the industry.

So important has the work became and so inadequate the facilities, that Mr. Norton has written the following letter, which covers the whole matter and which should be of interest to all concerned in this city:

Since our adoption of a code of rules on January 15th of this year, we have been able to cover only a very lim ited territory. With the necessity of reports in detail on all work inspected, our men are able to do only about one-third of the work which was formerly done. We are badly hampered by the ignorance and in many cases by the criminal negligence of the men whose work we are called upon to inspect. This class, I am happy to state, is small, and yet their presence is made painfully real almost every day. Perhaps the contractor has cornered a coil of "World's Fair" wire, or has been out of town for six months or a year, or possibly his forte is bell wiring, the result is the same.

The electric light wiring of Chicago is in wretched condition, and with our present inadequate equipment it will be at least three years before we could make a re-inspection of the wiring as it now stands. Think of adding three years to the service of the class of work as at present in use. We are meeting with gratifying support in our efforts, but unless we can extend our operations materially, we shall be working almost in a circle, and by the time we have made the circuit of the immense territory we are expected to cover, with its 22 central stations and 500 insulated plants, operating 15,000 arc lamps and 300,000 incandescent lamps—a territory almost co-extensive with the territory of the city, we shall be confronted with a state of affairs, better, it is true, than we find at present, but still furnishing abundant material for the inspector. It has been satisfactorily proven in our experience that a periodical inspection is imperative and we must face the fact that our work must be gone over completely at least every two years. Many special risks require even more attention and should receive re-inspection every six months.

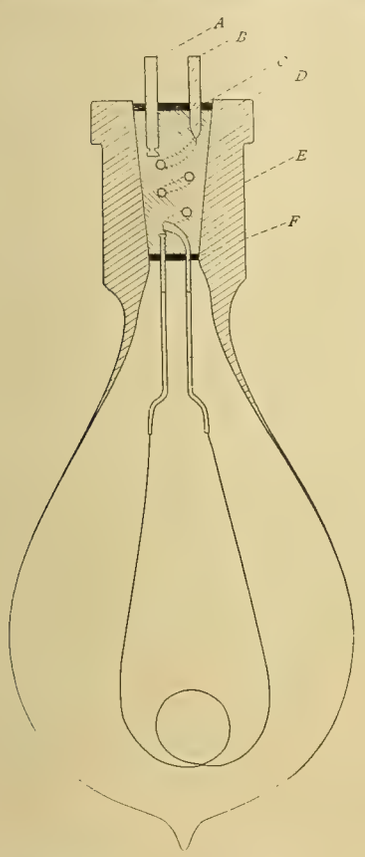
Our department is just about able to handle the new work submitted, and we must either cover the entire field hastily or go carefully over what we are able to reach. The work done in the past shows the folly of the first, and the second leaves much property equally valuable and deserving of equal attention in jeopardy from the serious fire hazard existing from defective wiring. Our department is more than self-supporting. From fees collected we could maintain a force twice as large as we are given at present, and also maintain an efficient laboratory, which is a necessary adjunct to an inspection bureau.

The Cicero & Proviso Street Railway company at last Monday night's meeting of the Chicago council asked for permission to lay, construct, maintain and operate a two-track street railway, with all necessary curves, side tracks, turnouts, turntables and switches, and with all necessary poles, wires and electrical conductors for furnishing electrical power for the term of twenty years upon that part of West Forty-eighth street, between the south line of Lake street and the north line of West Chicago avenue, and on that part of West Chicago avenue between the east line of West Forty-eighth street and the center line of West Fifty-second street, or west limits of the city of Chicago.

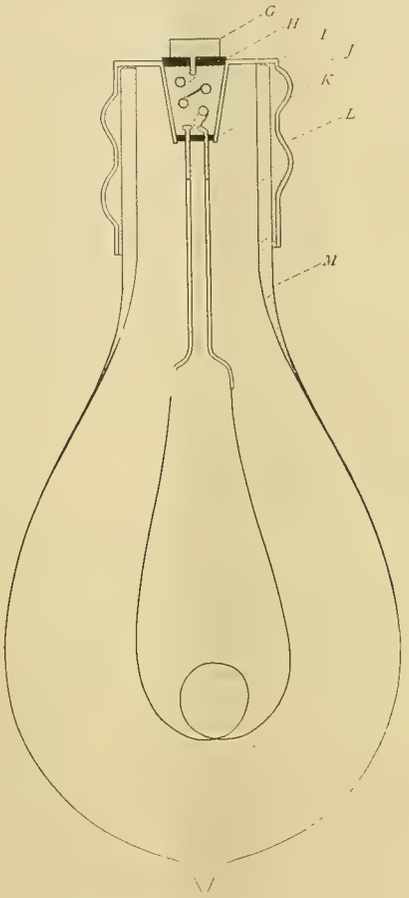
Peil-MacFadden Incandescent Lamp.

Two young Chicagoans, Carl K. MacFadden and John Peil, have invented and patented a new form of incandescent lamp that is said to be non-infringing. The idea is illustrated by the accompanying drawings, in which the parts are diagramatically shown. The principal feature of the new lamp consists in the use of an enameled inleading wire, which passes through a metal seal. The coat of enamel is very thin, but insulates the wire thoroughly. In Fig. 1 a lamp having a heavy glass neck, similar to that at present used by the Westinghouse company for its stopper lamp, is shown. Instead of having a ground glass stopper, however, a metal plug is formed by pouring melted metal in the opening in the neck, which not only makes a perfect seal around the inleading wires but also forms a fit with the glass, which is easily made air-tight.

The inleading wires are wound in spiral form before being enameled, and in this way a seal can be obtained of two or three inches in length when the melted metal is poured in. To simplify the construction somewhat, but one of the inleading wires is led through the seal, for the seal itself, being a conductor, can be used as shown in the cuts, and thus do away with the second inleading wire.



A—Terminal in metal seal.
B—Terminal connected to spiral enameled inleading wire.
C—Cement.
D—Metallic seal.
E—Glass base of lamp bulb.
F—Mica disk to prevent melted seal from running out of base when being made.



G—Metal terminal to enameled spiral.
H—Mica insulating disk.
I—Metal seal in cap.
J—Cement between cap and bulb.
K—Mica disk.
L—Metal cap to fit Edison socket.
M—Glass bulb with heavy neck.

FIGS. 1 AND 2. PEIL-MAC FADDEN INCANDESCENT LAMP.

In Fig. 2 a bulb having a rather heavy neck is shown, but a metal cap is fastened on. This cap contains the seal around the inleading wires. A copper or iron cap is provided with a flange opening inwardly, in which the melted alloy is poured in, sealing in the enamel covered inleading wires. The cap forms one terminal of the lamp, and is so formed as to fit the usual Edison socket. The inleading wire has an outer terminal, as shown, and it is believed that the lamp is a thoroughly non-infringing one. The cap itself is fastened to the glass bulb by filling the space between the cap and the neck of the bulb with a cement which softens at a fairly low temperature. The interior surface of the cap is coated with enamel, and by means of the smooth and clean surfaces no trouble is experienced in making a tight joint.

The lamps contain no plaster of paris or other absorbent insulating material and are thus waterproof. The parts may be separated and new filaments can be readily inserted. The use of platinum is entirely avoided, and the cost of manufacture is estimated to be from 3 to 6 cents less than that of the usual all-glass lamp.

Ordinance of the Mutual Electric Light Company Amended.

At Monday's meeting of the Chicago council Mayor Hopkins presented his veto of the Mutual Electric Light company's ordinance. As amended by the mayor, the company will be obliged to limit its charge for arc lights to $7 a month when they burn until 12:30 A. M., instead of $7.50. The Mayor insists that after the expiration of 10 years the percentage of gross receipts to be paid to the city should be increased from three to five per cent. Another amendment submitted was intended to guard against the absorption of the company by a trust. It was proposed that the company be required to permit the use of its poles and conduits to such other companies, to be designated by the council, as may in the future be licensed by the city, upon fair and equitable terms, to be either agreed upon upon or determined by arbitration. The company will be obliged to construct a plant, the bona fide cost of which shall not be less than $40,000, and which shall have a capacity of furnishing current for not less than 350 arc lights. For a failure to comply with such requirements the company is obliged to pay to the city the sum of $10,000. To insure a faithful compliance with this requirement the company must deposit with the city treasurer $10,000 in cash or city bonds, which, however, all be returned to it after it shall have expended $40,000 upon its plant, have strung twenty miles of wire and laid not less than two miles of conduits, and shall have a minimum capacity of 350 arc lights.

The ordinance as amended was passed by the council.

Electric Railway Affairs in Washington.

On March 12th the House of Representatives devoted the entire day to the consideration of a bill relating to the extension of the time for allowing a street railway company to change its system of motive power. According to an act passed several years ago, the street railroads of the District were required to change their motive systems from horse power to either cable, storage battery or underground electric. All but the Metropolitan company complied with the provisions of the law. That road claimed the cable was too expensive and tried the storage battery system.

Steam Engineering at the World's Fair.

At the February meeting of the American Society of Mechanical Engineers Prof. John E. Sweet read a paper on "The Steam Engine at the World's Fair." He tabulated the results of his observations as follows:

Most power in small space—Westinghouse, Willans, Schichau.
Largest and most economical—Allis.
Largest exhibit—Westinghouse.
Most economical high speed—Willans, English.
Best piece of steam engineering—German.
Best rotary—Swedish.
Best workmanship—French.

More Rapid Transit Proposed for Chicago.

Chicago in general, and the North Side in particular, will certainly have no cause to complain of the lack of rapid transit facilities if a small percentage of the proposed plans, "with heavy capitalists back of them," ever reach a material realization. Ever since the Northwestern Elevated Railroad company applied for a charter to construct an elevated road upon the North Side one scheme has followed another in almost bewildering rapidity. The latest claimant for rapid transit honors to make itself known is a company which intends to exploit the system illustrated by L. F. Cook in a model at the World's Fair. It was set up in transportation building and was in actual operation, attracting considerable attention from interested spectators. It is reported that Mr. Cook has succeeded in interesting a number of Chicago capitalists, railroad men and business men in his invention, and that articles of incorporation for a construction company will be filed in a short time and the city council asked for a franchise for an elevated road on the North Side. Those back of the scheme are said to be Thomas B. Bryan and Edwin F. Getchell and other well-known citizens, including Samuel W. Allerton, who are inclined to keep their names in the background. The chief advantages of the new system, as Mr. Cook explains them, lie in the small cost of construction and the high speed that can be attained in running trains. The road is designed on an entirely new principle and the structure takes up but very little room in the streets. It was fully described in the WESTERN ELECTRICIAN, September 30, 1893. The cars are one-half as large as the ordinary steam surface cars and are carried from the side, making it necessary to erect but a single line of posts in wide streets or an arch in narrow streets and alleys. These posts carry a steel truss with trolley contacts on each side, thus providing a double track. The car floors are on a level with the lower truss line, which makes the service much more compact and also saves passengers much climbing. The motive power to be used will be electricity. A company has been organized in St. Paul and Minneapolis to connect those cities by the new road, and it is said that trains will be running there within a year.

Electrical Machinery for Niagara Falls.

The General Electric company has just closed a large contract with the Cataract Construction company for the furnishing of about 2,000 horse power of apparatus to be used in the plant of the Pittsburg Reduction company at Niagara Falls. The apparatus in question will transform the two-phase current delivered from the station of the Cataract company at 2,500 volts into continuous current at 160 volts for the use of the Reduction company. The plant of the Pittsburg company is about 2,500 feet from that of the Cataract company. There will be furnished eight 200 kilowatt step-down transformers and four 370 kilowatt revolving transformers, for converting two-phase current into continuous current. It is believed that this will be the largest plant of the kind in the world, and the installation will mark an interesting step in the development of the use of multiphase currents for transmission purposes being again transformed into direct currents at the point of utilization. In addition to the apparatus mentioned the General Electric company also furnishes the necessary switchboard and accompanying appliances.

The people of The Potrero and of South San Francisco will soon have rapid transit to the heart of the city, for work was begun March 2d on the electric road which is to run on Mission street from the ferries at the foot of Market street to Thirty-first street. The Consolidated Street Railway company, which is largely owned by Southern Pacific managers, has been preparing for some time to convert its present horse railroad on Mission street into an electric road. The mayor tried to block the scheme, but Judge Slack held that the trolleys did not constitute a public nuisance, and dissolved the injunction. The railroad company has all the material on hand, and if no appeal to the Supreme Court is made, the road will be finished in a few weeks. It will do much to build up the southern suburbs, which now can be reached only by slow cars.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE activity displayed in electrical circles in the West since the beginning of the year, especially in Chicago, is encouraging and gives promise of a general revival throughout the country. It emphasizes, too, the importance of the West as a factor in the commereial prosperity of the country and cannot fail to impress eastern manufacturers with the fact that Chicago is the great distributing center of that territory. It is to be regretted that the reports from the East do not show corresponding prosperity; in fact it appears that public confidence has not been fully restored in the East, and the electrical interests, in common with others, are suffering from this general depression. This condition is generally attributed to the sensitiveness of commercial enterprises to Wall street influences, but, whatever the cause may be, it is certainly true that the East is several months behind the West in recovering from the general commercial depression. Numerous electrical projects in the West, involving the expenditure of large sums of money, which were temporarily dropped last year, have been revived, and the outlook is particularly encouraging for construction as well as manufacturing and supply companies throughout the West. It is with satisfaction that this marked improvement is noted, and it is to be hoped that similar advance will soon be seen throughout the entire country.

AT a meeting of the members from New York of the United States honorary commissioners to the Antwerp International Exposition, March 14th, it was determined to again call the attention of American manufacturers and producers to the advantages offered by the Antwerp exposition for the introduction of American apparatus in Europe. This action of the body would seem to indicate that American manufacturers have not taken the interest in the exposition that was anticipated. The commissioners also announce cheap freight rates, and that the exposition will positively be opened upon May 5th, as all of the main buildings are now completed. No fitter opportunity could be offered to American electrical concerns for the exploitation of their apparatus in foreign countries than this, and it would seem that the time as well as the comparative development of the industry upon both sides of the Atlantic is particularly favorable to a complete exposition of electrical machinery of American design. It is to be hoped that this branch of the United States exhibits will be well represented.

In an article on "Insolent Broadway Gripmen" the *New York Tribune* boldly states that "the gripmen on a number of the cars are so reckless that there have been more accidents in Broadway since the cars there were run by the cable than on any other line in the city." Dear, dear! Isn't this charge a startling neglect of the "deadly trolley" cry? There is at least one street railway company in New York that operates its line by electric power, and it is somewhat surprising that it is not excepted by the *Tribune* as being more dangerous than the Broadway cable line. It is true that the newspaper quoted has been probably the most conservative of those concerned in the New York onslaught on the trolley; but it is gratifying to find one New York journal which admits that there may possibly exist some street railway system which may become more menacing to human life than cars operated from overhead wires. The concession represents a step in advance.

ELSEWHERE in this issue is presented a description of the underground conduit system at Rochester, N. Y., illustrated with working drawings, which present the characteristic features of the system. The company which put in this system controls most of the electric lighting in the city, and furnishes street lighting for the municipality. At present the underground conduit system is confined to the business center of the town, yet it is one of the most extensive in the country. It has been constructed with much care and under the direction of one of the most experienced central station managers of the country. Mr. Redman has given this subject much careful study, and he has embodied in the Rochester system the best features of the work done in other cities. It is significant that in cities the size of Rochester a comprehensive underground system can be established and maintained where a few years ago such an undertaking would not be considered for a moment. It is sufficient proof of the great advances that have been made in the art. The results attained at Rochester will be watched with no little interest.

IT is curious that such an important and influential newspaper as the *Chicago Daily Tribune* should manifest such a ludicrous misconception of the simplest laws of electricity, or of physics, for that matter, as is shown by the following extract from an editorial in its issue of March 19th, entitled "Electricity on Railroads:"

The underground system is admittedly more costly to build than the overhead or trolley system, but it is believed it can be made less expensive to operate by recovering and returning that portion of the current which is lost after having passed through the motor of the car. A second wire is to be used to retain this surplus and prevent it from becoming waste, so that it may be used over again.

The idea of current being "lost after having passed through the motor" and of the introduction of a second wire to "prevent it from becoming waste, so that it may be used over again," is very good indeed. Poets tell us that it is impossible to grind with the water that is past, but the engineer of the *Tribune* evidently treasures the opinion that the hydraulic analogy does not hold good in this case. The plan of using the current "over again" is obviously one of immense possibilities. Just pump the circuit full of "juice," use the energy indefinitely for power purposes, and there you are! What could be simpler or cheaper? This stupendous discovery will be hard on the coal dealers, but it will insure for the inventor a niche in the temple of fame not far removed from that of the great and immortal Keeley himself.

VERY few persons have any idea of the extent to which electric lighting has been applied in Chicago. The inspection department of the city government announces that there are 22 central stations and 500 isolated plants in the city, operating 15,000 arc lights and 300,000 incandescent lamps. These figures are official and may be relied upon. The chief of the inspection department calls attention to the fact that much of the construction work, especially that which was done several years ago, is in a wretched condition and should be overhauled at once, but owing to the small number of inspectors furnished by the city it is impossible to do much more than keep up with the new work. Chief Inspector Norton says: "It has been satisfactorily proven in our experience that a periodical inspection is imperative, and we must face the fact that our work must be gone over completely at least every two years. Many special risks require even more attention and should receive re-inspection every six months." Of course if such a condition could be brought about the standard of construction would show material advancement and the effect upon the electrical interests would be beneficial. It is urged that the receipts of the department should be expended in improving and enlarging the service. Mr. Norton argues that the advantages to the city from the improvements in the service would repay it for this outlay.

RAPID transit for New York has received a serious shaking up during the last month, and the result has been the introduction of a bill in the Legislature providing for the abolition of the old board of commissioners and the appointment of a new commission. The present movement is directed principally by the Chamber of Commerce, and a committee of prominent capitalists is at Albany pressing the claims of the bill. At the present time much fault is found with the old commission, but there is no certainty that the new commissioners will be more successful. It is true that the commission has accomplished little or nothing in the long term which it has served, but this was not entirely the fault of the members. They worked faithfully and prepared several plans, listened to suggestions, complaints and petitions from thousands of interested persons, and laid out a comprehensive system of underground electric railways. But New York did not take kindly to the scheme at that time, the "L" interests opposed it and private capital was not forthcoming. Then it was that Banker Wilson presented his plan of utilizing the city's credit, but Mayor Gilroy thought that if the city's credit were to be drawn upon, the municipality and not a private corporation should enjoy the advantages. Hence the present plan advocated by the Chamber of Commerce committee. Under the proposed bill the commission will be empowered to build and operate the roads, if it is found desirable to do so.

THE *Elektrotechnische Zeitschrift* of Berlin, in reproducing Mr. Preece's comparative tables showing the use of telephones in British and American cities, which were given in the WESTERN ELECTRICIAN of February 24th, adds a table of its own, setting forth the member of telephone subscribers in the leading German cities. The comparison is very flattering to the Fatherland. In the larger cities of Germany it is shown that the number of telephones in use is much larger than in American towns of the first rank, while the averages for all the cities given for each country are about the same. In Berlin, for instance, there are more telephone subscribers than in New York and Chicago combined, the exact figures being 20,344 for the German capital, and 9,066 and 9,684, respectively, for the American cities. The proportion to population is one subscriber to 78.4 inhabitants in Berlin; one to 114 in Chicago, and one to 167 in New York. In Hamburg, a city about the size of Cincinnati, there are 8,026 telephone subscribers, the proportion to population being one to 40 8. This proportion is not equalled by any American city given in Mr. Preece's table, the nearest approach to it being Providence—a much smaller town—which has a telephone for every 45 inhabitants. The English show up very poorly in comparison with either Germany or the United States. London has no less than 636.3 inhabitants for every telephone subscriber, and in all the other British cities mentioned the proportion is high, except in Liverpool, where it is just about the same as in Chicago. Our Berlin contemporary is amply justified in its conclusion that "the showing in some of the German cities is very favorable, while that of England is very poor indeed."

Arc Lights on Incandescent Circuits.[1]

L. B. MARKS: The record of inventions in electric arc lamps during the last few years has shown that the trend of development has been in the direction of their application to incandescent circuits. As far as the underlying principle of operation is concerned, it may be said that the various types of arc lamps for constant potential circuits are practically the same. The differences are mainly in details. While the introduction on direct current incandescent circuits has been accomplished with a fair degree of success, the waste of a large percentage of energy in "dead" resistance is always involved; with a single arc across such a circuit the loss of energy due to resistance in series may be from fifty to sixty per cent; with two arcs in series across the mains the loss may be reduced to about twenty-five per cent. On 110 or 120 volt circuits economical conditions require more than one arc lamp across the mains.

The performance of a pair of lamps connected in series on a constant potential circuit proves the conclusion which may be arrived at from a theoretical study of the conditions; first, that it is impossible to maintain a constant current through the arc branch; second, that it is necessary to insert a wasteful resistance of some magnitude in the arc branch to secure even fair results.

In his admirable paper on "The Electric Arc and Its Use in Lighting," read at the National Electric Light association convention, February, 1891, Prof. Elihu Thomson, alluding to the application of arc lights to constant potential circuits, said: "A great deal of useless experimenting has been, and probably is yet, carried on with the vain endeavor of getting rid of the resistance or choking coil in this case, but the difficulty is inherent in the nature of the arc, the relation of resistance to current giving rise to instability of the current in the arc."

During the last few months C. Ransom and myself have been engaged in the development of what we believe to be an entirely new idea in arc lighting. I refer to what we have called the high potential incandescent arc. I have found that when the electric arc plays in an atmosphere of CO gas, the usual relation of current, potential difference and maximum efficiency for an electrode of given diameter does not hold.

By confining the arc in a very small bulb, filled with carbon gas, we have been able to efficiently reduce the current and greatly increase the potential difference; for instance, with a pair of electrodes which in the open air arc light give a maximum efficiency at 9 amperes and 50 volts, we have obtained excellent results at 4½ amperes and 100 volts, a condition impossible in open air arcs.

We have had no difficulty in running 100 to 120 volt arcs in this way, the current in each case being very small. The bulb we have used for the purpose is a modified Howard cylinder, containing a special device for controlling the inclosed gas.

When operated under these conditions the arc is about half an inch long and very steady. The violet hue so common to open air long arcs is not marked, the quality of the light being especially valuable for in-door illumination. The life of a pair of 7-16 inch carbons in a 500 watt lamp is about 100 hours.

The application of this system to incandescent circuits and its advantages over the present method are apparent. It dispenses with the necessity of running two lamps in series—a single arc without appreciable dead resistance being sufficient to bridge the mains.

It will be noted that the consumption of carbon is so slow that even if the points are fixed, the potential difference between the electrodes will not increase more than a few volts per hour. The comparatively rapid consumption of carbon in open air, and the consequent changes in resistance and candle power of the arc, are in marked contrast to the above, and suggest an important advantage of the inclosed arc for constant potential circuits.

In the method just described the two elements whose product equals the consumption of energy in the circuit are susceptible of a wide range of variation, and may be adjusted to suit the conditions, just as the primary and secondary coils of a converter allow of great flexibility.

With a potential difference of 115 volts between the carbon points and a current of four amperes, a single lamp consumes 480 watts on a 120 volt incandescent circuit, the amount of energy expended in the arc itself being 460 watts. The loss equals 20 watts per lamp, or 40 watts for two arcs, each directly across the mains.

Comparing these figures with the data obtained from existing conditions, we note that under the most favorable circumstances the loss of energy for two open air arcs, each 460 watts, across a 120 volt circuit, is 280 watts as against 40 watts in the first case. Thus, there is a clear saving of about 20 per cent. in energy accruing from the use of the high potential lamp. I shall not consider the case of a single open air arc across the mains, such an arrangement being extremely wasteful of energy.

In the lamp which we have constructed for our purpose we have two regulating coils differentially wound on the same core, and in series relation to each other, one coil being in series with, the other in shunt around, the arc. By properly proportioning the coils we have obtained a very sensitive feed.

Summarizing, the advantages which may accrue from the use of the high potential lamp on incandescent circuits are as follows: (a) Saving in energy; (b) saving in cost of trimming; (c) saving in carbons; (d) improvement in the quality of the light; (e) subdivision of the light; (f) cleanliness; no carbon dust or soot; (g) perfect spark arrester.

MR. BARSTOW: The low tension arc lamp was four years ago in much the same position as was until recently the alternating current motor, for while they were both practical it remained to be shown by actual practice on a large commercial scale that difficulties would not arise which would prevent their perfect success with the public. As the history of low tension arc lighting began on the system of the Brooklyn Edison company, I will simply give you as concisely as I can the advantages and disadvantages which have actually developed in commercial practice. The first disadvantages in which we were immediately interested were:

I. The requiring of a dead resistance in the circuit of the lamps, which meant lost energy.

II. The requiring for commercial reasons of the installation of lamps in pairs.

It will not be denied that a low tension direct current system can easily produce current cheaper by employing large units operating in multiple than can a high tension system with its larger number of small machines. There is to-day in this country a large company operating arcs on both high and low tension systems, and it has assured me that it costs them 25 per cent. less to manufacture current for low tension than for high tension arcs. This is taken from actual results of the last year. With this condition before us we can easily see that we can well afford to waste 10 per cent. of energy on our low tension system outside of our station, especially when the customer pays for it. This last may make a few of you smile, but this same thing is done in high tension systems, the only difference being that in the latter the waste occurs in the station in the employing of small units, the price to the customer including this waste (which appears in the operating expenses upon which the price is based)

The question of desirability of installing lamps in pairs must be answered by the customer, and in Brooklyn the results will warrant a strong affirmative.

In making a price for current for low tension arc lamps, there must be taken into account renewals the renewal of the lamp, resistance which will of course decrease in value as better methods of resistance are introduced.

In order to get the same price for an arc current, as for an incandescent current, which of course comes from the same generator, the price of current per 16 candle power lamp hour was taken as a basis. It was then found that 9 cents per hour for a 1,200 candle power arc lamp current corresponded with 8 cents per hour for equivalent incandescent current, as the proportion of arc lamp renewals exceeded the incandescent. As the cost of labor in trimming an arc lamp is the same whether the lamp is burnt for one, two or six hours, it was found that in order to be fair in a meter rate, a sliding scale should be used. Therefore, a scale commencing at 9 cents per lamp for the first hour and decreasing in proportion to the length of burning was adopted. It was further thought that if customers paid for current actually used without reference to the number of lamps installed, and the company was to loan the lamps there would be no limit to the number of lamps, asked for, while the customer would not bind himself to use all of them. This difficulty was easily settled by grading the discount price of current according to the average lamp hours per day, which was obtained by comparing the total current with the number of lamps installed.

The first lot of arc lamps wereinstalled in Brooklyn in the spring of 1890, and since then the progress has been very rapid, which can readily be seen in the fact that to-day we are operating almost 2,700 lamps with orders ahead for some 400 more—and now as to actual results.

It has been shown that our fears for low tension arc lamps, as far as the two disadvantages mentioned, were almost without actual foundation, and that we can to-day furnish lamps as cheap as our high tension competitors and still make as much profit as on our incandescent installation.

In my hurried departure from Brooklyn, I was unable to collect what data I desired, but will submit to you a complaint report on arc lamps for the year 1893, which will show more clearly the defects which we are now correcting:

Number of Ward lamps in use	2,246	
Number of Bijou lamps in use	400	
Total number of complaints	3911	
Defective carbons	2	per cent
Retrims	7	"
Defective adjustment	12	"
Fuses and plugs blown—unknown cause	10	"
Loose connections, caused by storms	6	"
Trouble with mechanism of lamp	12	"
Carbon holders broken and burnt out	1	"
Lamps grounded external	8	"
Defective cleaning	16	"
Defective house wiring	2	"
Resistances burnt out and grounded	5	"
Defective installation	1	"
No trouble when men arrived	10	"
Special complaints	8	"
Total number of trimmers	17	
Average number of lamps per trimmer	144	
Maximum number of lamps per trimmer	170	
Maximum trims per trimmer	182	
Labor and material for repairing, repainting rewinding resistances and changing lamps including testing of all new lamps	75 cents per lamp per year	
Globe renewals, exclusive of those paid for by customers	7 cents per lamp per year	

MR. SPENCER: Of course the introduction of arc lamps on incandescent circuits has been of gradual growth. The great advantage in using arcs in this way is the fact that one class of machinery only is necessary which will considerably cheapen the production of the current. This is the principal reason why the alternating arc lamp has been introduced, although anyone who has studied the problem knows that it induces a great many more difficulties than we experience in the direct arc lamp. In the first place the distribution of light from an alternating arc lamp is not all that is desired. It is one of the fortunate things about a direct current lamp that the light is produced on one carbon, and if that carbon is put uppermost the light is thrown down, and we get the full advantage of it, while in the alternating arc lamp we have the carbon meeting in both directions and the light that comes up in most cases is wasted. I think, however, that can be overcome by a proper designing of the lamp. The most serious objection to the alternating lamp is the noise; but in spite of the noise I think every central station man who has studied it has discovered that there is a wide field for it.

The criticism is made by our friends on the other side of the water, that in spite of our boasted advance in engineering in this country we are sadly deficient in the line of arc lighting. It is said that the arc lamps that are furnished to the public here would not be tolerated in any country in Europe. The trouble to-day is that Americans are using a carbon which no other nation would use. The noise of an alternating lamp can be greatly reduced by the use of a good carbon.

MR. ANDREWS, Philadelphia: I have introduced a considerable number of arc lamps on the incandescent circuit, replacing arc lamps hitherto operated on the high tension circuit. I have also introduced incandescent arc lamps in places which have been hitherto illuminated with incandescent lamps, and in this way I have increased the income of the station. In a great many cases customers have been paying $10 or $15 a month for incandescent lighting, and have been grumbling constantly about their bills, because they have not been satisfied with the quantity of the light. By changing them over to incandescent arc lamps, and by increasing their bills to double, and giving them four to ten times as much light, they have paid the extra money and have been perfectly satisfied. In this line I think the general tendency is that arc lamps on the incandescent circuit, although potential arc lamps, will eventually supersede the high tension arc lamps for many reasons. I think one of the principal reasons is that customers wish to be able to turn off and on their lights at pleasure—on dark days for example—and not wait for the regular arc circuits to be turned on.

MR. AYER: Do you use direct or alternating current.

MR ANDREWS: I use both. I have had some experience with the Helios lamps and I think the alternating arc lamp, as a class is a great addition to the central station income. The alternating current is far more flexible than the ordinary direct cuttent for incandescent lighting, and therefore we are able to apply it to places not ordinarily feasible with the Edison three-wire system. We charge our customers by meter exclusively; we have been charging hitherto fifteen cents per thousand watt hours, and giving a varying discount, according to the size of the bills.

MR. NICHOLLS: Does the company supply the carbons?

MR. ANDREWS: Yes, and trims the lamps. I would also desire to emphasize Mr. Spencer's remarks with regard to the effect of the carbons. I have tried nearly every carbon that is made in this country, and I have come to the conclusion that it is impossible to produce a perfectly satisfactory light. I think that as soon as the carbon manufacturers of this country are able to produce a carbon which will give the same effect as foreign carbons, it will give an additional impetus to the business, and it will be a great thing for central station managers.

MR. AYER: I think it is essential that we should emphasize this demand for a good carbon. In practice I know that it is easier to get more money for a lamp with a first class carbon than with ordinary carbon.

MR. VAN TRUMP: Two years ago we decided to place arc lamps on the incandescent circuits at Wilmington. We had at that time a number of series arcs running. We were not prepared to throw away our series arcs and buy low potential arcs for our incandescent circuits. We have at this time 150 lamps on our incandescent circuit, and we have increased our series business as well. We are getting a rate of ten cents a lamp hour—about 21 cents per kilowatt hour from our arc lamps: with a minimum charge of $2.50 per lamp per month.

The matter of arc lamps on incandescent circuits appears to have solved several problems. We are now undertaking with that system work that I would hesitate to try with incandescent lamps—that is the lighting of a large free library. We hang the lamps directly on the ceiling reversing the current and burning them upside down, with a large reflector underneath. The light goes on the ceiling; you cannot see the arc at all, and the room is thoroughly lighted from end to end.

1. Discussion at the National Electric Light association convention, Washington, D. C., March 1, 1894.

An Electrically Operated Ferris Wheel.

It is reported that a "Ferris Wheel" larger than that at the World's Fair will be erected in London this year. The accounts are rather hazy, but it is said that the wheel will be 300 feet in diameter, the whole structure standing 320 feet high. The number of carriages is to be 40. The axle will be a steel tube 50 feet long and seven feet in diameter. The standards which support it will be in the form of quadrilateral towers, with two of the legs inclined toward the wheel, the style being substantially similar to that employed by Mr. Ferris. These towers will have four floors, on which will be restaurants and other rooms for the public. Hydraulic elevators are planned to provide access to these floors. It is intended to operate the wheel by two electric motors of 50 horse power each, turning a drum driving large wire ropes, which will run in grooves on the periphery of the big wheel. At Chicago a 1,000 horse power engine was employed to operate the wheel by gearing on the outer rim, but it was found that a great excess of power was provided, and very likely 100 horse power would have been sufficient to slowly turn the nicely balanced structure.

Nicholson Compression Coupling.

The Nicholson patent flanged face compression coupling, which is shown in Fig. 1, in design, construction and general operation has proven to be reliable and possessing some distinctive features over old-style couplings. In appearance it resembles the ordinary flanged face coupling. The two half castings are bored tapering, and have flanges on the rim to cover bolt heads and nuts. The outer faces of the hubs are closed almost to the shaft by a rib or projection, through which slots are cut to place the keys or jaws in position while the coupling is being fixed on the shaft. The steel jaws have double taper, turned to fit bores of castings, and are concaved on their inner faces a trifle less than the radius of the shaft, which makes the grip positive when flanges are drawn up by the bolts. The couplings are constructed to allow a space of from 3/8 to 3/4 of an inch between flanges, thus enabling a trifle larger or smaller size of shaft than gauge size to be coupled. This feature will be readily appreciated, as it allows extra couplings to be carried in stock, so that, in case of an accident, they can be immediately applied to shafts which may have become broken or twisted off, or another shaft, may be coupled on without the necessity of key-seating the old shaft or making exact

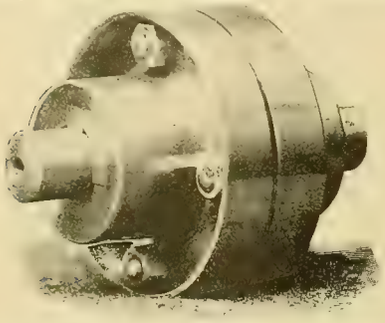


FIG. 1. NICHOLSON COMPRESSION COUPLING.

measurements to insure a perfectly tight fit. Fig. 2 shows the construction of the Nicholson coupling. It has been placed upon the market by the Link Belt Machinery company, Chicago.

Portable Thomson Recording Wattmeter for Street Car Testing.

It is frequently necessary in electric street railway practice to test the power consumption of the cars, and heretofore the General Electric company has furnished a 500 volt meter mounted rigidly within a mahogany box for this purpose. This was, however, found to be not without faults. Experiments have been going on for some time to evolve a satisfactory portable recording meter for the purpose named, and the General Electric company now announces one which will satisfy the many requirements of street railway service.

The meter in question consists of a Thomson recording meter mounted on a skeleton metal frame, and having a capacity of 25 amperes at 500 volts. It is mounted within a polished wood carrying case about two thirds the size of

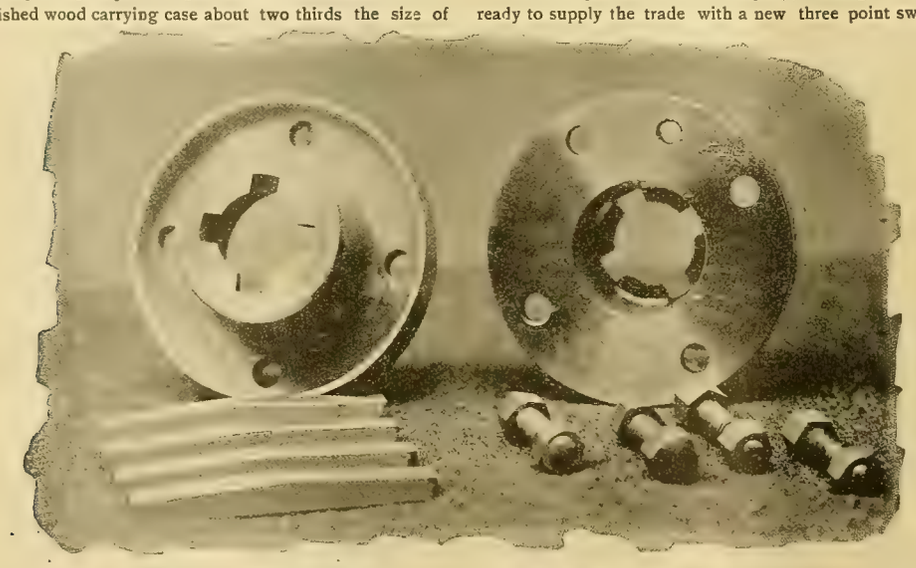
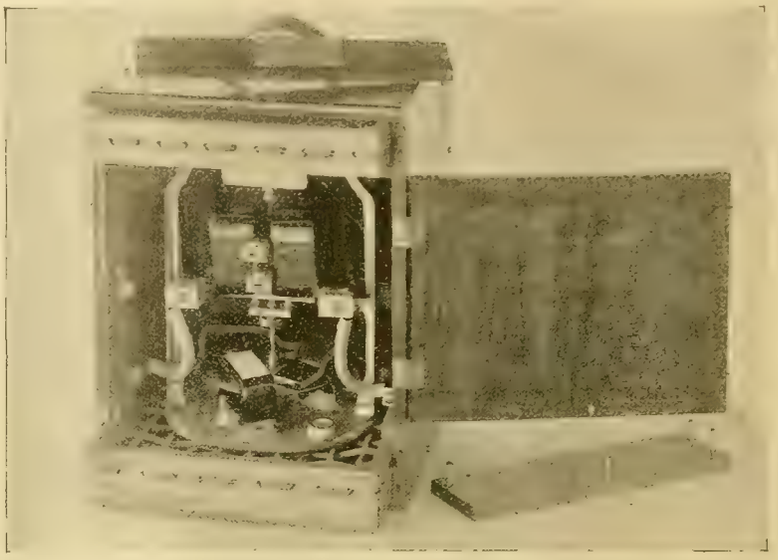


FIG. 2. NICHOLSON COMPRESSION COUPLING.

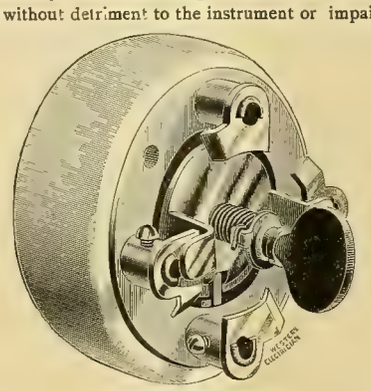
the former type. The meter is suspended between two networks of interlaced rubber cord, or, as it were, between two rubber hammocks. This method of suspension saves the meter from violent agitation or shocks, and renders its accuracy reliable. It is the first time that this system has been applied to the recording meter, and it is a feature which will recommend it to all street railway men. The meter may be placed upon the floor of the car with absolute safety and convenience, and gives perfectly accurate readings.

This portable meter, a cut of which is presented herewith, is normally rated at 25 amperes. In testing street cars, however, the current will frequently, for short intervals, very greatly exceed this as when starting, or upon heavy grades, but this meter is so constructed as to record



PORTABLE THOMSON RECORDING WATTMETER FOR STREET CAR TESTING.

these sudden bursts of current accurately; and enormous overloads may be carried through the meter for short intervals without detriment to the instrument or impairment



NEW THREE WAY SWITCH.

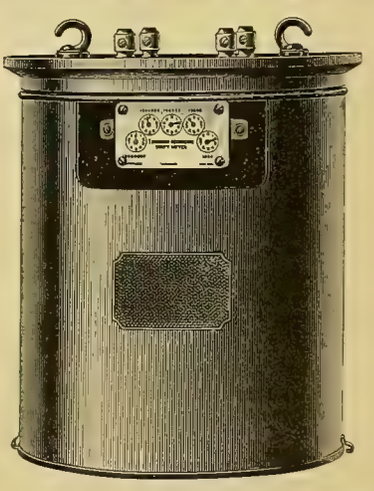
of its accuracy. The meter has been subjected to careful and severe tests with satisfactory results.

New Three Way Switch.

The Metropolitan Electric company, Chicago, is now ready to supply the trade with a new three point switch, illustrated in the accompanying cut. It is built on the lines of the popular "Xntric" switches and it is a modification of the 10 ampere single pole switch. The porcelain base contains four contact or binding posts instead of two, as in the single pole switch; two of these posts are joined together by a metal strip on the bottom of the base, making the three points, one double and two single contact posts. The contact arm always makes a contact between the double contact posts and one of the single posts. To change circuit, the handle is turned, and by means of the "Xntric" movement the arm flies, one end to the next single post and the other to the second part of the double post. An important feature in "Xntric" switches, is that the base, cap and handle of the five ampere and 10 ampere single pole, 10 ampere double pole, and the three point are all the same size. This greatly improves the appearance of switches when bunched together.

Thomson Recording Wattmeter for Arc Circuits

The success which the Thomson wattmeter for incandescent circuits has experienced has prompted the General Electric company to design a recording wattmeter to be used especially for the measurement of energy consumed in groups of arc lights in commercial lighting, such as in stores, factories, halls, etc. It is a true wattmeter, modified in its principles only to meet the change of conditions



THOMSON RECORDING WATTMETER FOR ARC CIRCUITS.

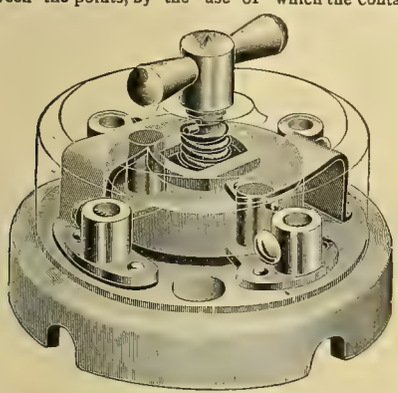
of arc light service. It is similar in construction to the Thomson recording wattmeter, and has the same damping device—a copper disk and two permanent magnets. It has been designed to be suspended from the ceiling by two brass rods fastened to a simple ceiling board, and is inaccessible except to those who understand its manipulation. A special feature of the meter is the safety cut-out contained within the cover proper. It is designed to close immediately on possible trouble occurring within the meter which might result in the burning out or breaking of the circuit. The cut-out serves to short circuit the meter and cut it out, rendering trouble in the meter impossible. At the same time it preserves the continuity of the circuit and permits the lights to burn without interruption.

The connections of the meter are exceedingly simple. The connection blocks are at the top, the wires being brought first to the ceiling board, and then dropped to the meter. The two terminals farthest from the front of the meter are connected to the line through a cut-out, the two front terminals being connected to the lamps in the house. The meter will run backward and register correctly, subtracting instead of adding to the sum on the dial. The

meter is shipped fully assembled and ready for installation. as swown by the accompanying cut. Careful tests show that the same accuracy can be expected on a minimum load as on a maximum.

New Perkins Switches.

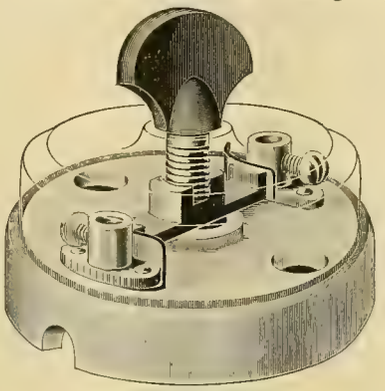
Probably no firm manufacturing electrical appliances is wider known for the excellence of production than the Perkins Electric Switch Manufacturing company of Hartford, Conn. In the Gibbs switch it presents an application of a principle which heretofore has for the most part been neglected in switch construction. As the handle of the switch, upon being turned from left to right, rises, by aid of a screw thread cut upon the same, a nut loose in the insulating block is pressed forward, as soon as released from the lock in the base of the switch, with great rapidity, and, after a quarter revolution, again falls back into a lock, where it is firmly held, these parts revolving only in one direction. A special feature of this switch is in the loose contact pins, which allow automatic adjustment between the points, by the use of which the contact is



NEW PERKINS SWITCHES.

assured with every point by the pressure of the strong, spring copper brushes, which upon one end of the pin force the other against the adjoining contact plate. When this contact is made the insulating block is free to move in any direction and therefore is prevented from binding the contact pin. This assures absolute interchanging simplicity and strength, which will recommend this switch to purchasers who have been annoyed by the breaking and inability to replace the parts of switches. The Perkins company has noticed the demand for a flush switch for use in residence and office installations, and has devised one in which is presented the novel feature, whereby a spring lock fastens the flush plate to a cast-iron box containing the switch, so that no one not provided with a specially designed key can remove the plate or turn the switch. The importance of this invention is at once seen, as it will only permit authorized persons to have access to the switch and recommends itself for use in theaters, public buildings, insane asylums and like institutions. The new porcelain switch for fine installations is constructed of plain white porcelain, but is also furnished with such decoration as may be requested. The new single pole switch, guaranteed to break a 500 volt current, although having only a 2¼ inch base, it is claimed, has been fully tested by the Massachusetts Engineering company of Boston, Mass., and recommends itself at once to the electrical trade. The same mechanical construction is used in this as in the double pole switches, but by a different arrangement a break of 1¼ inches is obtained, or more than one-third on each side, which it is claimed has not heretofore been obtained in switch work. This switch has a carrying capacity rated at 220 volts, with a 10 to 20 ampere current. Several of the switches manufactured, including the single and double pole types, are illustrated in the accompanying cuts.

The Perkins Electric Switch Manufacturing company

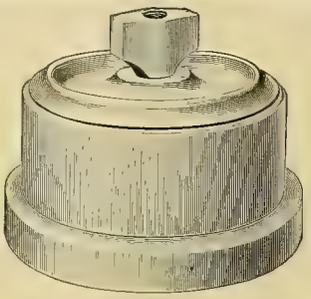


NEW PERKINS SWITCHES.

has recently purchased the entire business of the Waterhouse Lamp Manufacturing company of Hartford, and will shortly make it a leading part of its business. G. W. Conover, with offices in the Monadnock building, Chicago, is the western representative of this company, and he reports that he finds a decided increase in business since the first of the year and indications of a large spring trade.

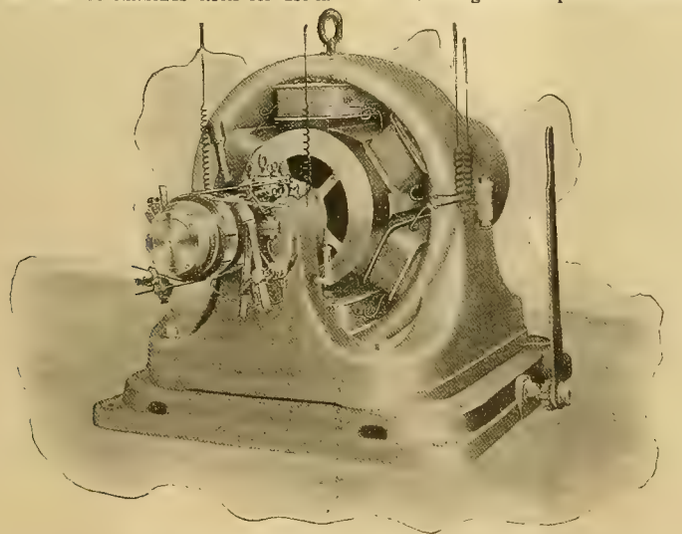
Westinghouse Direct Current Arc Generator.

The Westinghouse Electric & Manufacturing company has for a long time been carrying on a series of extended



NEW PERKINS SWITCHES.

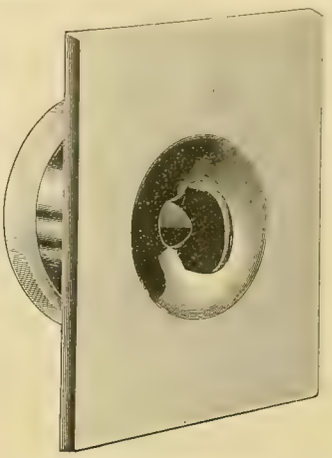
and elaborate experiments with a view of obtaining a machine which would better fulfill the requirements of direct current arc lighting than any heretofore in use. The results of these experiments have been embodied in the new direct current arc machine shown in the accompanying cut. It belongs to the open coil continuous current class and is similar in general appearance to the company's standard alternating current dynamos; that is, it consists of a circular cast-iron yoke, parted horizontally and having inwardly projecting poles. The armature is of the toothed type with lathe-wound coils, especially heavily insulated. Particular attention has been paid to the commutator of this machine. Satisfactory results are hoped for by the adoption of a new type which presents a large bearing surface for the brushes and which has the segments separated by half an inch of insulation, so that the apparatus is quite free from vicious sparking. Four sets of copper brushes collect the current without the use of "blow outs" or other devices intended to avoid sparking. The field coils are connected in series with one another. The exciting current is supplied from a separate low voltage machine, so that the use of high potentials in the field windings is avoided. The accompanying illustration shows a 60 lighter of this type rated for a speed of 750 revolutions. The efficiency claimed for this machine is 90 per cent. The lamps used upon this system are of nominal 2,000 candle power and of the rack feed type, affording the same method of regulation secured in the company's existing constant potential lamps.



WESTINGHOUSE DIRECT CURRENT ARC GENERATOR.

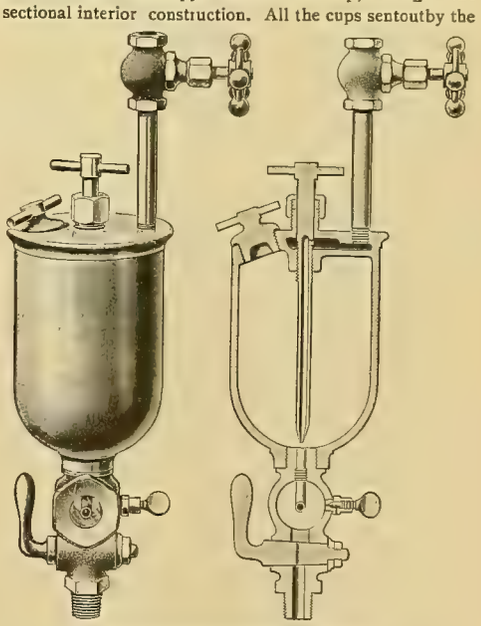
Graphite Sight-feed Lubricator.

The difficulty which has been experienced in properly supplying steam chests and cylinders of engines and pumps with graphite lubricant has been overcome by the Lunkenheimer company, Cincinnatti, O., in the device



NEW PERKINS SWITCHES.

known as the sight-feed lubricator for engine cylinders and steam pumps. This lubricator not only feeds the graphite automatically and continuously in desired quantities, but also does it visibly, by passing through a sight-feed. The cup may be attached like any ordinary sight-feed oil lubricator to the steam pipe above the throttle, and can also be attached below the throttle or on the steam chest, with the upper steam connection above the throttle. In Fig. 1 is shown the exturnal appearance of the cup; in Fig. 2 the sectional interior construction. All the cups sentoutby the



GRAPHITE SIGHT-FEED LUBRICATOR.

Lunkenheimer company are constructed of the best materials and are tested before leaving the factory.

Another Edison Lamp Decision.

By a decision rendered Tuesday Judge Ricks of Cleveland, O., denies the motion of the Universal Electric company to dissolve the existing injunction obtained against it by the Edison Electric Light company, restraining the Universal company from infringing the Edison lamp patents. The Universal company moved to dissolve the injunction on the grounds that by reason of a certificate attached to the Edison lamp patent in 1883, which referred to certain foreign patents for the same invention, that patent expired with the English patent last November, or, at any rate, that the Edison company was estopped from contending that it did not then expire. Judge Ricks defeated the Universal company on both grounds, and the injunction against that company will continue in force.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 19. — On Friday, March 16th, the bill prepared on the rapid transit situation by the Chamber of Commerce was introduced into the Senate at Albany. It provides for a new rapid transit commission, to consist of the mayor and comptroller of the city, the president of the Chamber of Commerce, and Samuel D. Babcock, Seth Low, John Claflin and Alexander E. Orr, with power to fill vacancies in its own number and legislates the present commission out of office. This is a very important period in the history of the attempts of New York to secure rapid transit, and it is to be hoped, if the bill becomes a law, that the new commission will take advantage of the efforts and the mistakes of the existing commission. For three years that body has been endeavoring to propose some plan that would be practicable and at the same time acceptable to the people. During this time many ideas have been advanced, many propositions entertained and many, many dollars spent. The commission has doubtlessly upon several occasions erred seriously, and it has been made to stand the brunt of severe criticism, but the importance of the project must be taken into consideration. While it is true that the visible results of the labor of the commission are not apparent, record of the obstacles which have militated against the proceedings of the body, must be borne in mind. There can be no doubt that the efforts of the gentlemen composing the commission were honestly devoted to the problem, which it was hoped they would solve, and although the body is at the present time unpopular, many valuable results and plans remain as the product of its investigations. However, the inaction of the commissioners, enforced, although it may have been at times, was very trying to the patience of the people who are complaining at the existing state of affairs. It is to be hoped the new commission will not share the fate of its predecessor.

The bill proposes an issue of bonds to pay for the construction of an underground road by a responsible corporation. When completed, a lease of the property for thirty years will be offered at auction and sold to the company making the highest bid. The successful bidder must pay interest on the city bonds and also an annual rental, the rental to be applied to a sinking fund for the retirement of the bonds. The first lease shall be terminated upon the retirement of the bonds. Then it shall be sold again to the highest bidder, on such terms as the city may prescribe, and resold every thirty years, the successful bidder for the lease purchasing from the previous lessee the rolling stock and other personal property at a price to be fixed by arbitration. Great care has been taken in the preparation of the bill, in order to surround with all possible safeguards the bond issue and the charter of construction, operation, and supervision of the work. It is proposed that a board of engineers shall pass upon or suggest economies of construction and operation and that the work shall be supervised by a commission, to be composed of men of the highest reputation.

Few have doubted that an underground road would ultimately be decided upon, and the advantage of electricity as a motive power under such circumstances are so plainly apparent that it is well nigh a foreseen conclusion that it will be adopted. Such an advent would be of the most practical importance to the electrical profession in this country and would impart an impetus to research and invention for improvements particularly applicable to the demands of such a system that would be far reaching in its results. The career of the bill introduced into the Senate last week, will be watched with great interest.

Large delegations of business men from New York and Buffalo attended the joint hearing given March 14th, by the Senate and Assembly Committees on Miscellaneous Corporations on the bill which proposes to reduce telephone charges. The bill was introduced by Senator Parsons and Assemblyman Gerst, of Erie County. It proposes to establish a graded rate of telephone charges in cities of different size throughout the state and to create a commission which shall have jurisdiction over the companies. Many speakers, among whom was C. C. Shayne, the representative of the New York Board of Trade of Transportation, spoke upon the subject and were practically unanimous in condemning the existing telephone rates as too high and in appealing to the Legislature for relief. Hamilton Harris, representing the Metropolitan Telephone company and the Albany company, asked for time in which to prepare a statement showing the rates now existing. It would be impossible, he said, to have one fixed rate for telephones of all classes in a given city. The rates in New York city varied, he said, from $80 to $240, according to the kind of service demanded. As to increase in rates, of which there had been complaint, this was necessary because of the increased expenses. The Metropolitan company had not paid a dividend the last year. The Albany company had never paid a dividend on its stock. John G. Milburn of Buffalo spoke briefly on behalf of the Bell Telephone company of Buffalo. He also asked for time in which to prepare a statement. The joint conference granted the request of the representatives of the telephone companies for time in which to prepare statements as to the cost of telephone service. Another hearing will be held in two weeks.

Vice-Chancellor Van Fleet, of Newark, N. J., granted an order March 7th restraining the directors of the Edison United Phonograph company, which holds foreign patents, from holding an election in Edison's works, at Orange, on the same date. R. Wayne Parker made the application for Colonel Gouraud of England, and Thomas A. Edison and A. Q. Keasbey appeared for Jesse Seligman and other partners. The election was postponed for two weeks, and the vice-chancellor will hear arguments this week in regard to votes in dispute. The stock is equally divided among different parties. Colonel Gouraud alleges that he sent two shares of stock from England in time to be registered for himself and Mr. Edison before the twenty days' limit, but that the other parties neglected to register the stock, thereby disqualifying the two votes, as the by laws provide that no stock transferred within twenty days before an election can be voted. The vice-chancellor said that, if Colonel Gouraud proves this, he will see that he has the right to vote the stock. Mr. Keasbey holds, however, that Mr. Eaton, who neglected to register one share, cannot vote in the election, as the opponents of Mr. Edison are not to blame for the neglect to register this share. If Mr. Keasbey gains his point, his clients may control the election.

Frank W. Hawley, vice-president of the Cataract General Electric company, received a fifty-year permit, March 12th, from Superintendent Edward Hannan, of the State Department of Public Works, for his electric company to put in an electrical plant along the lines of the state canals, by which boats can be operated with electricity by the trolley of another system. The company shall not charge for use of such power by the canal boatman at a rate exceeding $20 per electrical horse power for each season of navigation. Mr. Hawley says that is the maximum charge that can be made, but that the rate will undoubtedly be much lower. Even at $20 a horse power, he says that an owner would saved 50 per cent. a season on the operation of his boat in comparison with the present cost of canal boat propulsion.

The company will obtain its electrical power at Niagara Falls, from the Niagara Power company, and transmit it to Albany, along the line of the Erie Canal. There is another company, having the same directors as the Cataract company, called the Erie Electric Towing & Power company, with its principal office in New York. This company will construct and put in operation as soon as possible a half dozen tug boats operated by electricity, either on the storage or trolley system, with the view of showing the adaptability of electricity to canal navigation. These tug boats will also tow, for a moderate consideration, any horse boats, the captains of which desire to avail themselves of such method of navigation. These two companies are subsidaries of the Niagara Power company.

The permit granted, authorizes the company to enter upon all canal lands of the state for the purpose of constructing either on, or over, or under either canal bank a system for propelling canal boats by electricity, without interfering with the present method of operation. Central power houses may be erected. The rates for towage shall be subject to modification and review by the state superintendent of public works, but such rate shall not exceed $20 per electrical horse power for any season of navigation. An important provision is that the company may, so long as the wants of the canal are supplied, employ its electric plant along the line of the canal in furnishing electric light, heat and power for distribution to any point or points beyond the line of the canal, and thus may furnish electricity for lighting and power purposes in all of the cities and villages along the canal. The company is to furnish the state, free of charge, sufficient power to operate motors to open all gateways leading to and from locks, and also electric lights sufficient to properly illuminate such locks at night. The company must have its plant for operating boats by electricity in operation on the Erie Canal between Buffalo and Albany within three years from date, or else the privileges accorded by the permit shall be forfeited.

In case the company shall construct along the canals an electrical plant for use known as the trolley, or traction system, it shall be the privilege of the state to condemn and purchase such property at a price equal to the actua original cost to the original constructor, with 10 per cent.' added thereto. All work done by the company shall be subject, as to times, places and manner, to the approval of the superintendent of public works. All damages growing out of the use of electricity on the canals shall be borne by the company, and the state shall in no way be put to any expense on account of the granting or operation of the permit. The company has not yet formally accepted the permit. The granting of the permit was to a certain extent distasteful, and many expressions of dissatisfaction have been heard. The Cataract company has it in its power to demonstrate the practicability of electrical haulage on the canal and now that the project is safely under way the outcome will be impatiently watched.

Rumors have been in circulation lately in Wall street that the governors of the Stock exchange proposed to take action on the question submitted some months ago to a special committee as to the desirability of cutting off all the telephones connecting the floor of the Exchange with the private brokerage offices. A large number of the members of the governing committee are said to be strongly opposed to brokers who do an "arbitrage" business between this city, Boston and Philadelphia, on the ground that it gives some members of the New York exchange an unfair advantage. Several of the larger firms have direct telephone connection between their offices here and the floors of the Boston and Philadelphia stock exchanges. Those firms can give an order for the sale or purchase of stocks in Boston or Philadelphia, which will be immediately executed. Then the direct telephone wire also enables them to cover those sales or purchases in the New York market. It is claimed that the advantage obtained by making simultaneous quotations, say in Boston and New York, secures to them business which would otherwise be more widely distributed among houses not having such facilities in the way of direct connections. No action upon the subject was taken at the last meeting of the exchange.

Judgments were entered last month against the La Burt Automatic Electric Block Signal System & Car Coupler company of No. 203 Broadway—one, for $341, in favor of Asa J. Stott, for salary and the other, for $2,019, in favor of George B. Lane. The sheriff received an execution on the Stott judgment. The company was incorporated in August, 1892, under West Virginia laws with a capital stock of $5,000,000 to push the invention, of John La Burt.

An interesting test was made recently at the headquarters of the fire department on East Sixty-seventh street of an electric hose signal, which, when placed in operation, is more than likely to prove of great assistance to firemen. The apparatus, as it was exhibited, consisted of a battery and bell placed at some convenient place on the engine and connected electrically with the discharge pipe by two insulated wires running through the fabric of the hose, fully protected from external damage and wholly clear of the waterway. These are fastened into the metal couplings between the several sections. The couplings are so constructed that when they are screwed up in the ordinary way the electrical connection is complete. A push button is placed on the nozzle ready to the hand of the hose man. By pressing this when the apparatus is in service he can ring the bell on the engine and convey any information to the engineer that may be arranged by an established code of signals, after the manner employed on steamships. The system is that of Howard Sargent of Boston.

A lecture was delivered before the New York Electrical society, on March 15th by T. C. Martin upon "The Electric Lighting of the World's Fair." The lecture was illustrated by a series of lantern slide pictures, and covered the lighting effects which were produced at the fair. Particular attention was paid to the electric fountains, their construction and operation, as well as the Court of Honor. Mr. Martin acknowledged his indebtedness to Luther Stieringer for his co-operation and assistance in preparing the material for the lecture.

W. F. O.

Milwaukee, Wis.

MILWAUKEE, March 17.—There has been a sort of revolution in the street railway and electric lighting interests of Milwaukee. Henry C. Payne has withdrawn from the active management of the street railways, and E. C. Wall has resigned as president and general manager of the Badger and Edison Illuminating companies. They have been succeeded by C. D. Wyman of New York, who has had considerable experience in the street railway business.

Recently both the Milwaukee electric railway and the West Side railway passed into the control of the Mil-

waukee Street Railway company, and that company now owns all the electric lighting systems and all the street railway lines in the city. It is a New Jersey corporation, and William Nelson Cromwell of New York is its president. All of the Milwaukee companies controlled by the New Jersey corporation maintain separate organizations, the directors and officers being Milwaukee men, principally the employes and attorneys of the main company. Ever since the organization of the Milwaukee Street Railway company Mr. Payne has had charge of its street railway interest and Mr. Wall has managed the electric light business. Mr. Payne is one of the receivers of the Northern Pacific Railway company. He is president of the Wisconsin Telephone company and one of the directors of the First National Bank. On account of his other interests he has been anxious for some time to get rid of the task of detail railway management, and he has finally succeeded. He will continue to serve as vice-president of the main company, and as one of the board of directors. He is the only Milwaukee man who is a director or an officer of the company that controls every mile of street railway track and every electric lamp in the city. Mr. Wall virtually resigned as manager and president of the electric light companies a year ago, though the fact has just leaked out. It appears that the directors were desirous that he should retain the management for a while longer, and that he consented to do so. Mr. Wyman arrived in the city late last week, and Vice-president Payne at once issued an order installing him in the active management of the road. The financial and auditing departments, according to the order, will continue to report to Mr. Payne. Mr. Wyman, who is a native of Racine, Wis., was the manager of the New York belt line and of other street railway systems. The first thing he did was to inspect the company's lines in Milwaukee, which are more than a hundred miles in length, and it will be few days before he will have his preliminary survey completed. The system, he declares, is a model one, and he says that he will be satisfied if he keeps it up to its present state of efficiency. He will not attempt to acquaint himself with the electric lighting departments of the company's business until he has completed his examination of the railway system. It is announced that the coming of Mr. Wyman will make no change in the other officers of the company.

At the annual meeting of the Wisconsin Telephone company it was reported that for the first time in its history the business of the company had taken a backward step. The total number of telephones in use was less by 400 than at any other time in the company's annals. When people began to feel the effect of hard times, Manager McLeod explained, the very first thing that they did was to order out their telephones. All of the 400 telephones taken out, of course, had not been used in Milwaukee. The company's field of operations covers the entire state, and it sustained some loss of business wherever it had an exchange. At the annual meeting of the company the old officers were re-elected, as follows: President, Henry C. Payne; vice-president and treasurer, Frank G. Bigelow; secretary and general manager, John D. McLeod. The board of directors consists of Messrs. Payne, Bigelow, Charles Ray, C. G. Stark, Fred Vogel, Jr., A. G. Fuller and B. K. Miller. E. B. Cottrill is the general superintendent. During the year the company responded to 4,300,000 calls in Milwaukee alone, and had about 175,000 toll messages between cities in different parts of the state. No new points were reached, but the company renewed about 100 miles of old wire. Two new metallic circuit lines were built to Waukesha. That place is the distributing point for toll messages between Milwaukee and the South and West, and there are now four metallic circuit lines between that town and Milwaukee. The company on January 1st had 6,992 subscribers, 2,522 being in Milwaukee.

What threatened to be serious trouble between the telephone company and the down-town druggists was settled a few days after the annual meeting. The company had attempted to establish pay stations in the drug stores, and the druggists, who wanted to have their customers, especially the physicians, use the telephones whenever they desired, strenuously objected. The company wouldn't budge from its position: the druggists appealed to the telephone subscribers in general to help them in their fight against the company, and steps were taken to call a mass meeting. The telephone contract prohibited the use of the telephones by any but the subscribers and their employes, but the druggists asserted that the provision was a dead letter in Milwaukee, as it probably is in all large cities. The matter was finally settled by the company's withdrawing its order for the establishment of pay stations in the down-town drug stores, but the understanding was that a new class of telephone subscribers, to consist of druggists and others whose use of the telephone is excessive, should be established, and that a higher rental should be exacted from that class of subscribers.

Just before and at the time that the Bell telephone patents expired there was a great deal of talk about the establishment of new telephone lines in Milwaukee and of giving telephone service at low rates. Many people expected a rival telephone company at once. Two different parties appeared to jump into the field, and there was considerable noise for a time, but nothing has come of it. A gentleman who has looked into the matter states that the new telephones will have to be improved considerably before they will be very formidable to existing interests. Some time in the future, he says, a company with a capital stock of half a million dollars may be formed to start a new telephone system in the state, but nothing seems to have been done. In one way, however, the expiration of the Bell telephone patents has already had an effect. Business houses, especially manufacturers, whose different departments have to be connected by telephone, are ordering out the instruments put in by the Wisconsin Telephone company, and are buying the cheap machines outright and putting them in. C.

PERSONAL.

G. Luthy, manager of the Royal Electric company, Peoria, Ill., was in Chicago last week.

A. Mitchell Hall, general manager of the C & C Electric company, New York, was in Chicago last week.

H. C. Whitney, manager of the motor department of the Interior Conduit & Insulation company of New York, is in Chicago.

H. J. Jampolis, well known to the electric light men of Chicago, was injured at a fire on Randolph street on the 15th instant by tripping over a line of hose and breaking his leg.

Cyrus Robinson, who has occupied the position of designing mining engineer of the General Electric company for the last three years, has resigned that position and has accepted a similar one with the Jeffrey Manufacturing company, Columbus, O. Mr. Robinson has an excellent record as a mining expert and construction engineer and the Jeffrey company is to be congratulated on its new acquisition to its already competent staff.

NEW INCORPORATIONS.

Ideal Light & Power company, Chicago; capital stock, $10,000; W. K. McKee, Chicago.

Northern Electric company, Chicago; capital stock, $50,000; Robert Mulhardy, Chicago.

Electric Power company, Portland, Me.; capital stock $500,000; E. C. Ramsdell, Cambridge, Me.

Electric Smelting & Aluminum company, Chicago; capital stock, $100,000; Alfred H. Cowles, Chicago.

ELECTRIC LIGHTING.

An electric light plant is to be put in at Greenwood, Miss.

Hooper, Neb., is to be supplied with a small electric light plant.

An effort is being made to introduce electric lights into Cassopolis, Mich.

P. L. Brady, Hearne, Tex., expects to put in an electric lighting plant in that place.

All the electric lighting companies of Ottawa, Ont., are to amalgamate in June.

Fire on March 8th destroyed the old electric plant on Noyes Island, Binghamton, N. Y.

Beare Bros., Humboldt, Tenn., are in the market for an electric lighting plant for that city.

A number of the citizens of Fostoria, Ohio, are interesting themselves in an incandescent light plant for their town.

The almshouse at Norristown, Pa., will be lighted by electricity. The Westinghouse company secured the contract.

The citizens of Sheldon, Ill., want electric lights, and a petition asking for an opportunity to vote upon the question has been put in circulation.

The Alma, Wis., electric light plant was destroyed by fire the first of this month. The origin of the fire is unknown and there was no insurance.

Neosho, Mo., is to have electric lights. The company upon whose recommendation the plant was selected proposes to furnish machinery to supply 30 arc lamps of 2,000 nominal candle power and 500 incandescent lamps of 16 candle power.

TRADE NEWS.

The twenty-ninth annual catalogue of the officers and students of the Massachusetts Institute of Technology, Boston, with the statement of the courses of instruction and a register of the alumni, is out. It is a book of 250 pages and gives an excellent idea of the scope of the work pursued at the institute as well as the particulars of the subjects and methods of instruction. Examinations for admission to the first year's class will be held in the Rogers building, 491 Boylston street, Boston, on the Thursday following the last Wednesday in June and on the first Tuesday after September 17th. Entrance examinations will be held in June only in New York, Philadelphia, Chicago and other principacities.

The Hornberger Electric Manufacturing company, Elkhart, Ind., has recently issued its new catalogue descriptive of its Elkhart transformer. The book is a neat one and tells all about this particular style of transformer, which is of the toothed type. The transformer is illustrated in all its details, and a number of letters in the back of the book testify to the excellence and reliability of the operation of this company's instrument.

The electrical society organized at Cornell University last fall has proved of so much benefit to its members and so much interest has been taken in it that it has been determined to publish the proceedings of the society and the valuable papers which have been read before it. The main objects in doing this are to bring the society to the attention of the electrical fraternity and to give non-members the benefits of the papers and the discussions upon them. The book will be issued in May and will contain the papers nearly up to the close of the college year. Charles E. Barry of Ithaca has the matter of publication in charge, and it is safe to presume that such a volume would be of value and interesting to students of electricity and its applications as taught at Cornell University.

F. E. Reed & Co., 120-124 Gold street, Worcester, Mass., has issued an illustrated catalogue of lathes and other machine tools. It is pleasing to note that the firm has adopted the size recommended by the American Society of Mechanical Engineers for a standard size of machinery catalogues. The dimensions of the book is 6x9 inches; this makes it possible to bind into one book for reference such catalogues of machinery as are most used or found desirable. The catalogue contains a description of the works of the firm at Worcester, Mass., and explains in detail most of the machinery it turns out. A special feature is made of the lathes manufactured by the firm and it is evident that it is capable of turning out about every size or design of this class desired. The book is well illustrated and the subject matter is exhaustive.

BUSINESS.

G. W. Conover, Chicago, western manager of the Perkins Electric Switch Manufacturing company of Hartford, Conn., reports the outlook for business as very encouraging.

Albertson & Co., Open Board of Trade, Chicago, have in use a set of magneto telephones furnished by William Hubbard & Co., 94 La Salle street, Chicago, through which stock reports are furnished.

E. Kuhlman of the Hornberger Electric Manufacturing company was in Chicago last week looking after the interests of the Elkhart toothed type transformer. Mr. Kuhlman reports a steady increase in business and many inquiries concerning his transformer.

Julius Andrae, well known throughout the West as the pioneer electrical supply dealer of Milwaukee, has just completed the refitting of his large store, which was recently damaged by fire. A large, new stock of specialties has just been received, and the firm is now fully prepared to give prompt attention to orders. One of its latest additions is the viaduct telephone, of which the company has sold a large number during the last few days.

The Calumet & Hecla Mining company has placed the order for a new iron building with the Berlin Iron Bridge company of East Berlin, Conn. The building will be 40 feet wide and 125 feet long, covered on the roof and sides with the Berlin Iron Bridge company's patent anti-condensation corrugated iron. The iron work for the extension to the E. W. Bliss & Co. foundry building, at Brooklyn, N. Y., will also be furnished by the Berlin Iron Bridge company.

The Bryant Electric company, with western office at 1522 Monadnock building, Chicago, announces that it has for sale a quantity of No. 4 and 5 weatherproof wire. The wire has not been used, but has come into the possession of the company during the course of trade. This is something of a special offer, as the company is not handling wire of any kind. The specialty of the company is in the production of switches, for which it has achieved an excellent reputation.

The Wisconsin Electrical Construction company has completed enlarging its quarters and is now occupying Nos. 451, 453 Broadway, Milwaukee. The company has added an extensive show room located on the second floor, which, it is claimed, is the finest of its kind in Milwaukee. It carries in stock a complete line of electrical specialties, including motors and dynamos. The company recently sold a three horse power C & C motor to one of the brewing companies in Milwaukee, and although it is being subjected to the most unfavorable conditions, it is said to be giving perfect satisfaction.

The Sunbeam Lamp Manufacturing company, Chicago, has recently brought out new lamps of six, eight and ten candle power, which are claimed to be equal in efficiency to the lamps of higher candle power. The six candle power lamp is used largely in sign work and decorative work, and a proper distribution of lamps of lower candle power will make a considerable saving in the cost of incandescent lighting without giving less satisfactory results. This company has also recently commenced the manufacture of a sixteen candle power 50 watt lamp an efficiency of 3 1-1 watts per candle.

The Electric Storage Battery company of Philadelphia, manufacturer of the Chloride accumulator, recently issued a challenge to the manufacturers of other types of storage batteries, demanding a comparative test under what

would seem to be trying conditions for the Chloride cell. Failing to receive an acceptance of the terms it proposed, but having noted that its proposed test was regarded by a rival company as valueless as far as establishing the question of durability and efficiency in actual service was concerned, the Electric Storage Battery company proposes to this company that it may name the conditions under which it would consider a test practicable to determine the relative commercial value of the cells. The Chloride company advances the claim that the Chloride cell has more than 50 per cent. greater commercial value than any battery manufactured in this country and states that it is prepared to meet any conditions necessary to determine the correctness of its statements.

It is gratifying to the Metropolitan Electric company of Chicago to announce that it will shortly open a branch store in St. Louis. This move has been made necessary owing to the extension of the company's business interests in the West. The new store will be under the management of experienced and thoroughly competent men and a large increase in business is expected. The company has been meeting with a large demand for its well-known construction material and is well satisfied with the sales made in this line. The company is constantly introducing new specialties, always of worth, and its latest departure is in the shape of a dry battery which will be classed along with the other Metropolitan specialties. The company believes that there is a large field for a good article of this kind and it is making extensive preparations to push the sale of its new battery. Another novelty which will be well advertised by this company is its new covered porcelain branch blocks. The other articles, which are handled by the Metropolitan company and which have become familiar to the electrical trade, have been meeting with an excellent sale and the company feels that it has no reason for complaining about the prevailing hard times.

The announcement of the intended removal of the Central Electric company of Chicago to larger quarters is an indication of the continued and remarkable prosperity of the company. Despite the dull times the business of the company has been steadily upon the increase until it has entirely out-grown its old quarters on Franklin street—in itself a large store—and the company has been compelled to seek a building. About May 1st the Central Electric company will move to 173-175 Adams street, the building formerly occupied by the General Electric company. Here with a floor space of about 26,000 square feet the company will have more ample room for the expansion of its business and for the exhibition of its wares. In the store occupied at present it commands only 12,000 square feet. The Central company has taken the agency for the Helios alternating direct current lamps for incandescent circuits and will push the sale of this specialty with its accustomed vigor. The iron armoured conduit of the Interior Conduit & Insulation company, for whom the Central company is the general western agent, has met with much favor from architects lately and several installations have been recently contracted for in buildings in Chicago. To satisfy the constantly growing demand for a better and thoroughly reliable carbon, the company has imported directly a large quantity of the well-known Hardmuth cored carbons and is in a condition to supply any reasonable demand that may be made for them. The Central Electric company looks for a still farther extension of its business after its removal into its new home.

The firm of Benj. F. Kelley & Son, 91 Liberty street, New York is so well known to the trade in general from its 12 years' of business experience in New York that it is not necessary to state that it is the manufacturer of the Standard feed-water heater. The Standard feed-water heater is constructed upon absolutely scientific principles. It may generally be described as consisting of a cast iron shell, containing a number of Π-shaped, seamless drawn brass tubes. The feed-water enters the side of the base and after circulating through the tubes, taking heat from the surrounding exhaust steam, is discharged from the opposite side at a temperature of from 200 degrees to 212 degrees F. without back pressure. The exhaust steam enters the shell near the bottom, and after heating the water leaves at the top of the heater. It may then be used for heating purposes or discharged into the atmosphere, as desired. Every heater is subjected to a cold water pressure of 200 pounds, thus insuring absolute tightness. The company has issued a book containing an amusing story of a father who loaned his factory to his three sons, and how the long-headed youngest son made himself solid with the paternal ancestor by purchasing a Berryman feed-water pump, thereby adding to economy and winning the factory for his own. The company intends to begin the manufacture of the Berryman feed-water heater, as the patents upon it have expired, and in all probability an agency will be placed in Chicago. This feed-water heater is used in connection with the plant of the West Chicago Light & Power company, which is illustrated and described in another part of this issue.

Westinghouse, Church, Kerr & Co., whose recent removal from their old offices at 17 Cortlandt street, New York, which they have occupied for the last 10 years, to their new offices, consisting of a suite of four large connecting rooms and a private hall on the sixth floor of the Havemeyer building, 26 Cortlandt street, was noted a short time ago, are to be congratulated upon their larger and more commodious accomodations. The success and excellent reputation of this concern is unquestioned, and it is gratifying to note its continued prosperity. It may be said that there is scarcely any concern of just its kind; for it is not an agent, although selling the product of others; it is not exactly a manufacturer, although owning and operating shops on ten acres of ground in Chicago; it is not in the professional consulting engineering business, although consulted by a large clientage, nor can it be exactly styled a contracting firm, although constantly executing important contract work. The fact is, it is a "kind" of its own making, wherein professional engineering, selling, manufacturing and contracting, and especially the developing of new and better things, are judiciously combined. The plan of the firm in general seems to be the development of one thing at a time, and when in condition to need no further attention, beyond ordinary improvement, its manufacture and sale is conducted through usual channels and another new project is taken under consideration. Among the varied undertakings, the ones that appear most conspicuously may be mentioned in connection with the Westinghouse engine, invented by H. H. Westinghouse, and built by the Westinghouse Machine company, and with the engineering development of which, from the small, simple form to the large compound type, it has been closely identified. In mechanical stoking of coal the firm was early in the field, and has been a leader in this class of engineering. The concern has been foremost in the application of the mechanical exhaust draft, and was a leader in the revolution from simple to compound engines, which occurred about six years ago. At the end of its first ten years of existence it is evident that the firm is an unusually progressive organization. It has a large corps of assistants and branch offices in the principal cities.

It is a matter of recognized fact that the West is rapidly becoming a manufacturing country. Heretofore, in the electrical line particularly, the territory in and about such cities as St. Louis and Chicago, might truly have been referred to as a "country of agents." To-day, however, and especially since the World's Fair so thoroughly advertised the advantages of the West, bright and conservative business men are being more and more attracted. It is not often that one finds an Eastern man who will frankly admit that the West presents a wider and more rapidly growing field for manufacturing, but those in the battery and carbon business, who have received the notice recently issued by the Hayden-Booker Manufacturing company, St. Louis, Mo., will appreciate that there are two pushing, thoroughly experienced and practical men in the electrical business who fully understand the situation and feel it is to their advantage to take time by the forelock. The Hayden-Booker Manufacturing company starts well equipped to carry on the manufacture of all kinds of open and closed circuit cells, and, in fact, everything in the battery line. One needs but know the personnel of the company to feel that its prospects should be exceedingly bright. If experience is worth anything, the Hayden-Booker company makes its start in the front rank. The mere mention of the name of M. M. Hayden, the company's president and manager, is synonymous with experience in the battery line. Mr. Hayden is widely known to battery users in this country, having been for six years in charge of the battery interests of the Law Telephone company of New York. He was its president and manager, and only severed his connection with that company in order to embark in what seemed to him to be a broader field. When one calls to mind that Mr. Hayden worked his way up in the electrical business from messenger boy to telegraph operator, was for two years a lineman in telephone work, was employed by the old United States company in construction work, and after a number of promotions found himself in charge of the construction work of the West India Telegraph & Telephone company in Jamaica, where he built two telephone exchanges—when one takes all this in consideration, along with a knowledge of his business experience in the management of the battery interests of the Law Telephone company, it is not hard to believe that the Hayden-Booker company is in a position to fill orders which should prove thoroughly satisfactory to experienced, practical men. Col. S. G. Booker is so well known in the carbon trade as to need no introduction. The Colonel was in the Confederate army and some of his intimate friends whom he allows to be familiar, refer to him even now as a "reconstructed rebel democrat." Col. Booker, like Mr. Hayden, came to his present position in life through work, and likewise is a graduate of the telegraph key. He was an operator on the Virginia & Tennessee railroad, occupying the position at the same time when stationed at Christiansburg, of postmaster, freight agent, etc., and was at times even a justice of the peace. After the war the colonel was in the banking business, and, then, started in as a manufacturer of carbons. The Fidelity Carbon Manufacturing company, at the time Col. Booker combined his interests with those of Mr. Hayden, was known as one of the most prosperous in the business, and now that the battery business is to receive particular and expert attention, the prospects appear brighter than ever. The company states in its circular that there has not been a galvanic cell really manufactured by any of the companies now exploiting cells. The object of the Hayden-Booker company is to manufacture cells throughout, and at the present time it has already worked up a stock from which large demands may be filled. With Mr. Booker, then, as a carbon maker and Mr. Hayden as a practical battery manufacturer, it does not take a prophet to point out what seems to be the new company's inevitable future.

ELECTRICAL PATENTS.

Issued March 13, 1894.

516,188. Electric Railway. Mark W. Dewey, Syracuse, N. Y.

516,198. Automatic Heat Regulating Apparatus. Charles F. Goodhue, Boston, Mass.

516,204. Magnetizing Coil. John D. Ihlder, Yonkers, N. Y.

In order to prevent the disruptive discharge upon opening the circuit of a dynamo due to the counter-electromotive force set up in the field windings an extra winding is provided of high resistance and in shunt with the magnetizing coil, but wound so as to oppose the same. Under normal operation but little current is diverted through the shunt winding, but upon opening the circuits currents are set up in both coils, due to the change of flux through the core, the current in the auxiliary coil being such as to oppose the rapid fall of magnetization of the core.

516,212. Electric Perforating Pen. Aaron D. Lewis, Canton, Mo.

516,213. Alternating Current Motor. Robert Lundell, Brooklyn, N. Y.

The motor is provided with a pair of stationary inducing field coils and a movable or rotary armature provided with a series of coils having their free ends attached to a current-collecting device and combined with fixed and movable pairs of current-collecting brushes and shunt circuits connecting the brushes together in pairs.

516,217. Rheostat. Herbert McNulta, Bloomington, Ill.

516,239. Electrical Protection for Safes. Charles F. A. Sturts, San Francisco, Cal.

516,253. Secondary Battery. Edwin R. Whitney, Manchester, N. H.

516,263. Electric Motor. Oliver F. Conklin, Dayton, O.

516,298. Dynamo-electric Machine. Frank J. Crouch, Portland, Ore.

516,312. Process of Electric Metal Working. Hermann Lemp, Lynn, and Walter S. Moody, Chelsea, Mass.

516,336. Car Lighting. Willard M. Miner, Plainfield, N. J.

A branch extends from the main line exterior to the car in which are located in series electric lamps for lighting the car, a storage battery being placed in series with the lamps and charged during the passage of the current through the lamps. Should the external source of current cease, the battery is automatically thrown into circuit with auxiliary lamps to furnish light during extinguishment of the regular lamps.

516,341. Safety Device for Electrostatic Measuring Instruments. William E. Ayrton and Thomas Mather, London, Eng.

The working parts of the instrument are arranged to be readily insulated from the terminals of the instrument, and subsequently short-circuited so as to bring the working parts to the same potential, so that they may be safely handled for the purpose of renewing the safety fuses.

516,374. Closed Conduit Electric Railway. Frederick L. King, Chicago, Ill.

516,379. Switch for Secondary Batteries. Hermann Müller, Nuremberg, Germany.

516,433. Telephone Toll Station Instrument. William T. Gentry, Atlanta, Ga.

516,447. Commutator for Electric Machines. Camillo Olivetti, Ivrea, Italy.

516,478. Electric Lock. John R. Donnelly, Fairfield, Me.

516,484. Regulating Socket for Incandescent Lamps. Morris D. Greengard, St. Louis, Mo.

516,487. Electric Current Regulator. Charles D. Haskins, Brooklyn, N. Y.

The regulator is for maintaining constant the current of an arc light dynamo by shifting the brushes about the commutator, a motor being provided in the circuit of the dynamo, whose speed is adapted to increase with increase of the current strength to throw into operation a frictional device that effects the shifting of the brushes.

516,492. Electric Trolley Device. Charles Knapp, St. Louis, Mo.

516,497. Self-regulating Dynamo. Isaac N. Lewis, Fort Wadsworth, N. Y.

The potential is maintained constant irrespective of the speed of rotation of the armature, the field magnet being provided with an auxiliary winding which opposes the main winding, the increase of current strength due to increased speed causing increased current to traverse the auxiliary winding to cut down the field strength in proportion to the increase of speed, a practically constant potential irrespective of speed being thus produced.

516,495. System of Car Lighting. Heating, Etc. Isaac N. Lewis, Fort Wadsworth, N. Y.

516,498. Electric Switch. Isaac N. Lewis, Fort Wadsworth, N. Y.

516,500. Electro-mechanical Gong. Morris Martin, Boston, Mass.

516,506. Interior Telephone System. Thomas McCoubray, New York, N. Y.

516,508. Electric Heater. Jeremiah O'Meara, New York, N. Y.

516,524. Suspended Electric Fan Motor. Julian F. Denison, New Haven, Conn.

516,552. Telegraph Apparatus. Josiah A. Parker, St. Louis, Mo., and Leland L. Summers, Chicago, Ill.

516,553. Armature for Dynamo-electric Machines or Motors. William B. Sayers, Glenwood, Bearsden, Scotland.

516,558. Automatic Block Signal. John D. Taylor, Chillicothe, O.

516,574. Electric Arc Lamp. Fred L. McGahan, Indianapolis, Ind.

516,598. Electrical Railway Signal. Ira L. Green, Kittanning, Pa.

516,626. Closed Conduit Electric Railway. Edward H. Brown, Salem, Mass.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents expiring during the week ending March 13, 1894:

188,444. Lightning Rods. N. Van Loon, St. Cloud, Minn.

Western Electrician.

EVERY SATURDAY.

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Plant of the Pabst Heat, Light and Power Company of Milwaukee.

With the introduction of a high class of directly connected electrical machinery, many central stations have been installed which may be taken as models of what an efficient and well arranged plant should be. One of the finest direct connected central station plants in the West is that of the Pabst Heat, Light & Power company of Milwaukee. As seen by the illustration, Fig. 1, presented upon this page, which gives a general idea of the dynamo room, including two of the dynamos and the marble switchboard, the plant has been constructed with an idea of affording ample floor space so that additions may be made from time to time. Already the present capacity of the station has been found to be inadequate and additions are contemplated immediately. The building is also about to be enlarged by the addition of several stories, the facade being unfinished as will be noticed by reference to Fig. 2 in the group. The front of the building is finished in terra cotta brick and presents a very neat and pleasing appearance. The territory covered by the company's franchise includes the entire business district of Milwaukee, and extensions in the service are being constantly made. The present electrical capacity is about 7,000 16-candle power lamps, but, in addition, the company furnishes power for operating elevators in the neighborhood and for other purposes. The ultimate capacity of the plant is estimated at 50,000 lights.

The electrical apparatus used is that of the Siemens & Halske Electric company of America, and is of superior design and construction. The three large direct current dynamos are coupled directly to three vertical engines built by the Lake Erie Engineering Works of Buffalo. The marble switchboard, Fig. 3, is of a decidedly handsome appearance and contains the efficient switchboard apparatus of that company. In Fig. 4 a view is shown of the boiler room which comprises a battery of Campbell & Zell boilers of 300 horse power capacity each.

The pumping machinery is entirely of the Worthington type and is one of the interesting features of the plant, while the hugh chimney attracts much attention. It is 185 feet in height; is constructed of steel trussed and lined with brick and is regarded as one of the most substantial structures of its kind in the country. The steam plant was planned by the Osborne Steam Engineering company of Chicago. It is under the supervision of Mr. Richardson and Mr. Kruse acts as consulting electrician, the whole being under the management of W. G. Parker, who is officially connected with the Pabst Brewing company. It is said that Capt. Pabst is very proud of the station and devotes much time and attention to it.

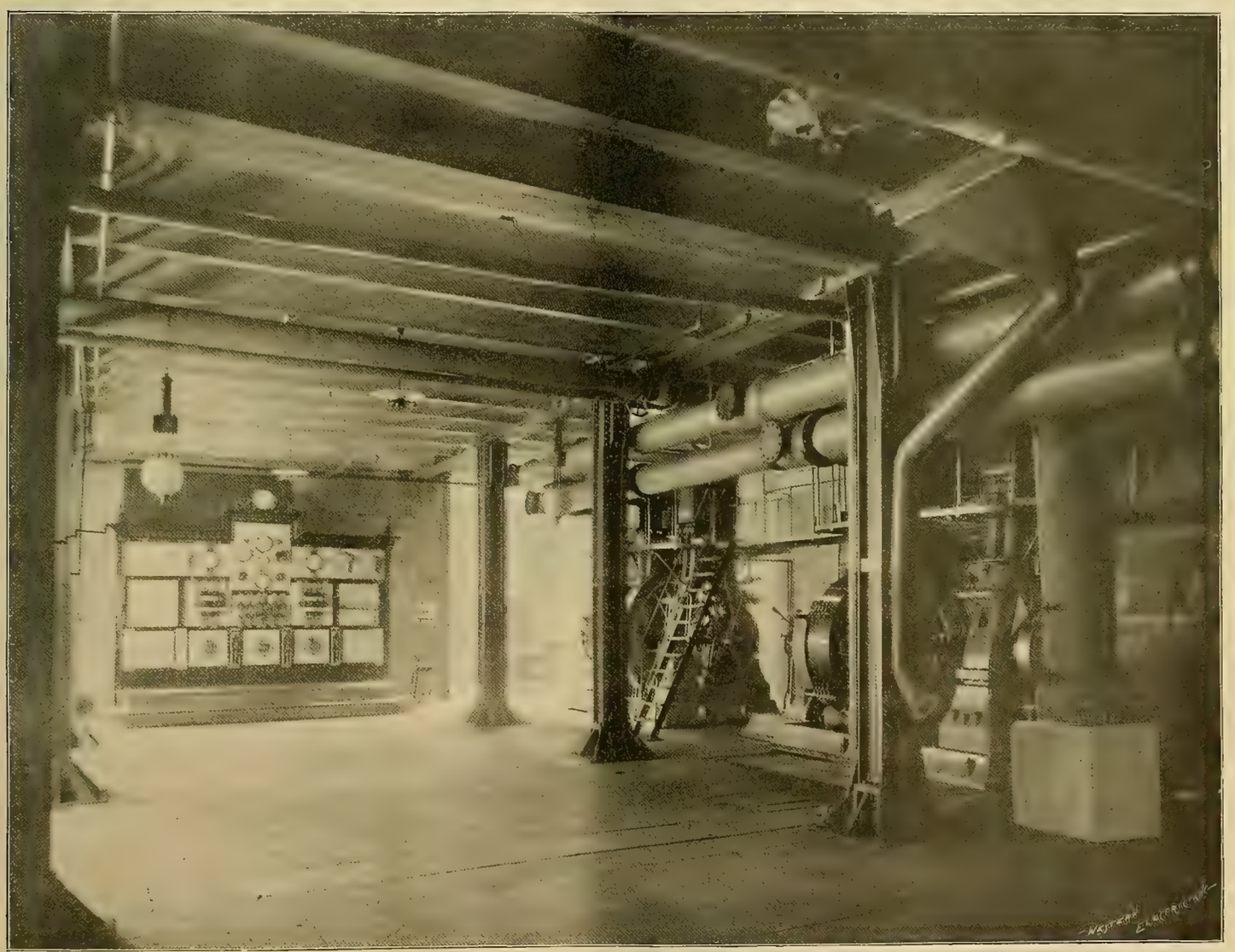

FIG. 1. PLANT OF THE PABST LIGHT, HEAT AND POWER COMPANY, OF MILWAUKEE.

Among the many novelties in the new electric light system of the Hotel Ponce de Leon, in St. Augustine, Fla., are forty marble-lined panel boards at different points in the building, each of which contains an original switching device by which every light in the building can be controlled directly by the man in charge.

American Institute of Electrical Engineers.

At the last meeting of the Institute, March 21st, a paper "On the Effect of Heavy Gasses in the Chamber of an Incandescent Lamp," was presented by Prof. W. A. Anthony of Vineland, N. J. The discussion was opened by Prof. William Lispenard Robb of Trinity College, Hartford, Conn. A meeting of the Chicago members was also held simultaneously, at which the same paper was read and discussed at the Armour Institute. The author was represented at Chicago by Prof. Dugald C. Jackson of Madison, Wis. Through the courtesy of the Metropolitan Telephone & Telegraph company, the American Telephone & Telegraph company and the Chicago Telephone company, telephonic communication was established between the two meetings, with A. S. Hibbard at the Chicago terminal and J. J. Carty in charge of the arrangements in New York city. President Houston at New York, spoke over the wire extending congratulations upon the success of the dual meeting, and informing the Chicago members that the report of the Committee on Units and Standards had been approved recommending the provisional adoption of the term "gilbert" for the C. G. S. unit of magneto-motive force, the "weber" for the C. G. S. magnetic unit of flux, the "oersted" for the C. G. S. unit of reluctance and the "gauss" for the unit of flux density.

At the council meeting in the afternoon, the following associate members were elected: Cornelius R. Agnew,

New York; C. O. C. Billberg, Philadelphia, Pa.; William L. Bliss, Brooklyn, N. Y.; E. R. Carichoff, New York; Herbert B. Coho, New York; J. Fred Galletly, Chicago, Ill., Henry Jackson, Lancashire, England; Edwin R. Keller, Philadelphia, Pa.; John W. Kirkland, Schenectady, N. Y.; Leo A. Phillips, Newark, N. J.; William F. B. Rouquette, New York; Henry A. Rowland, Baltimore, Md.; J. Brodie Smith, Manchester, N. H.; Dr. Ernst Voit, Munchen, Germany.

The following associate members were transferred to full membership upon recommendation of the board of examiners: George H. Almon, Boston, Mass.; Ernst Egger, Vienna, Austria; W. H. Brenner, Montreal, P. Q. Clark C. Haskins, Chicago, Ill.; James S. Fitzmaurice, Sydney, N. S. W.

Upon recommendation of the sub-committee on papers and meetings, it was voted to hold the annual and general meetings of the Institute in Philadelphia, May 15th and 16th.

As required by the rules, the council also canvassed the nominations received from the membership during the month of February, and prepared the following ticket for the coming election, ballots for which will be issued in April: For president, Edwin J. Houston; for vice-presidents, William A. Anthony, Francis B. Crocker and James Hamblet; for managers, A. E. Kennelly, W. D. Weaver, Charles S. Bradley and William B. Vansize; for treasurer, George M. Phelps.

Fig. 4. Fig. 2. Fig. 3.

PLANT OF THE PABST LIGHT, HEAT AND POWER COMPANY OF MILWAUKEE.

Dfferential Block System.

Owing to the frequent accidents which occur on railroads in spite of the many devices which have been introduced to protect the roads, inventors are constantly endeavoring to perfect some more absolute method of warning engineers of the presence of open switches, drawn bridges, an approaching train and other causes of these accidents. Electricity has been utilized to a considerable extent in some of the latest systems, and in one of the applications of this kind which seems to have been worked out with much attention having been paid to the details and to the demands which must be made upon it, electricity is the most important factor. This system is known as the Collins' electric differential block signal system and was invented by J. R. and A. F. Collins of Chicago, who have spent much time in developing it. In this system it has been made possible to divide the road into blocks of any desired length and to cause the blocks to vary according to the movements of the trains. The principal idea of the invention, which is illustrated in Fig. 1, is to run two steel strips, *a a* two inches wide and one-fourth of an inch thick, laid side by side at an angle best suited to avoid short circuiting by water, between the tracks on a 5 by 5 inch timber bolted solidly to the ties. The strips are laid continuously and unbroken except when crossings or switches obstruct their passage and there they are connected by insulated copper wires laid underneath the track as at *B B*, Fig. 2. This makes a continuous circuit from one terminal of the line to the other. In the engine cab it is intended to have an indicating mechanism connected with a primary battery and the leading wires connected with two brush wheels making contact with the conductors, and secured in a suitable frame. The resistance of one mile of each of the steel plates or strips will be made equal to the electromotive force of the battery; therefore, should a train approach as near as a mile to a drawbridge, an open switch, or any other short circuit, the engineer would be notified by the ringing of a bell in the cab of the engine. If two trains were running in the same direction on the same track and the first one should come to a stand still, the rear train upon coming within the proscribed distance would be automatically notified of the fact.

By referring to the cuts some of the applications of the system may be understood. In Fig. 2 is shown a view of two double track roads crossing at right angles, and the method of connecting up the circuit so that trains a mile from the crossing may be notified of their proximity to each other. An open split switch is shown in Fig. 3, as well as the method by which the system is short circuited automatically when the switch is opened. A draw-bridge is shown in Fig. 4 and the method illustrated of short circuiting the current in case the bridge is opened from either direction. The most striking application of this system is that explained in Fig. 2 where two double tracks cross each other. It will be seen that should two trains approach the crossings at right angles the circuit would be completed in the same manner as if both trains were on one track. By the connections resorted to it was intended to make it impossible to short circuit the wires at the crossing itself, so that the engineer is not signalled to stop unless a train should be within the mile limit of the crossing and running toward it. Should each right hand track leading to the crossing be short circuited by incoming trains, each indicator would record the circumstance, for each engine would be supplied with an independent battery and all the engines would therefore be signalled simultaneously.

The detail drawing in Fig. 3 shows the device that automatically closes the circuit when the switch is thrown open. Draw bridges are provided with two racks, *A*, *A*, Fig. 4. A pinion, *B*, is secured permanently to a tie as shown. When the bridge is swung either way the racks operate upon the pinion and throw the bolt with its double brush, *B B*, against the steel strips and causes the current to be short circuited. Each end of the bridge is provided with this attachment as seen in the detail of Fig. 4. The 5 by 5 inch timber holding the steel strips in position, elevates the strips above the level of the rails so that the brush wheels in passing over switches or crossings do not come in contact with the rails crossing at right angles.

Of course the importance of the indicating mechanism in a system of this character is of the utmost importance. This portion of the apparatus is illustrated in Fig. 5. It comprises an electric bell, a spool of paper operated by clock work and a solenoid magnetic regulator, so that not only audible warning is given in case of danger but the distance from the danger is measured and indicated upon the indicator. The register paper is made in continuous sheets, in five foot lengths, and it is wound on the spools *A* and *B*, Fig. 5. The sheets are ruled into time and space

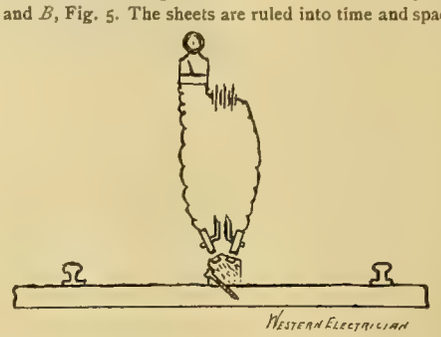

FIG. 1. DIFFERENTIAL BLOCK SYSTEM.

division, minutes being recorded by the horizontal movement of the paper actuated by the clock work set in motion automatically when the circuit is completed. The space divisions register one mile, one-half mile, one-fourth mile and one eighth mile, the smaller divisions being indicated in feet; thus it is possible for the engineer to know exactly how near to the place of danger he may be. The clock work stops automatically when the mile limit is reached. The pointer carries a glass syphon pen and it is actuated by the core in the solenoid, which draws it farther in as the resistance of the strips becomes less. At one end of the lever a contact is made when a circuit is formed and the bell rings continuously by an independent current, so that the indicator is not deprived of energy from this source, or the bell may be switched out of circuit if desired. As this indicator records in ink, a register is kept, to which reference may be made for the purpose of determining the responsibility of any accident that might occur attributable to negligence on the part of the employes.

Liverpool Overhead Railway.

So much has been written in reference to the overhead electric railway in Liverpool, England, that an authentic report of its operation and a description of its equipment is interesting. The line is the only elevated city passenger railroad in England. According to the *Railroad Gazette*, from which this article is taken, a shareholders' meeting was held February 13th and the first half year's report of working was submitted. The passenger train mileage was 243,539, and the total passengers carried were two and a half millions; being, first-class, 260,000; second-class, 1,294,000, and workmen on special return tickets, 922,000. The average load (computed) was about 50 per train, the total capacity of each train being 114 passengers seated. The report states that 95 per cent. of the trains were punctual on a five minutes headway, which incidentially speaks well for the automatic electric signals. The financial earnings of the road as shown by the report seems to have been satisfactory.

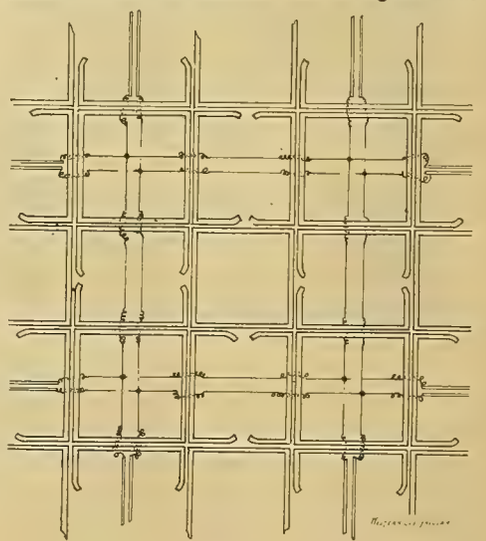

FIG. 2. DIFFERENTIAL BLOCK SYSTEM.

At a meeting of the Institute of Civil Engineers, in London, held last month, a paper was read by James Henry Greathead and Francis Fox, the consulting engineers of the Liverpool overhead road, on the construction, equipment and the results of operation of the road. This

paper was supplemented by one on the electrical equipment of the road written by Thomas Parker, engineer for the Electrical Construction Corporation, of Wolverhampton. the firm contracting for the equipment. Abstracts of these papers are reproduced herewith:

Where trains are heavy and long, and where the weight on the driving wheels is not a consideration, separate locomotives may be preferable, because it is undesirable to multiply machines, and it is an advantage to have all the machinery under the eye of the driver and readily accessible—in tunnel railways also there is more space for the motors in separate locomotives. In cases, however, where it is important to limit the weight on the driving wheels, motor cars afford an opportunity of running trains of any length without undue weight being thrown upon the structure. For instance, on the elevated railways of New York the structures will not admit of heavy locomotives, and though the traffic is such as to tax the carrying capacity of the trains, run at the shortest possible intervals, to its utmost limit, and beyond considerations of convenience, larger trains cannot be introduced unless the structures can be strengthened or motor cars be adopted.

Lighter trains resulting in better speed with a given expenditure of power, also follow from the use of motor cars. As an illustration of this, derived from actual experience, the trains of the Overhead Railway may be compared with those of the City & South London railway. In the former case the electrical equipment for motive power adds 6 tons 7 hundredweight to the weight of carriages seating 114 passengers, while in the latter the corresponding weight (the locomotive) is 10 tons 7 hundredweight, 96 passengers being carried. The avoidance of shunting at the terminal stations is another important advantage attending motor cars. Every separate movement of even a light locomotive absorbs a comparatively large current, thus accentuating the irregularities of demand, already sufficiently variable, upon the generating engines and dynamos. Time is saved at the terminal stations and siding accommodation is reduced in length. Wear and tear of all kinds are reduced, and the first cost of the trains is considerably less.

The design of the carriages, Fig. 1, received much consideration, and the result is satisfactory both as regards weight and convenience. One train consists at present of two carriages, each 45 feet long and 8 feet 6 inches wide, on two bogies 32 feet apart from center-pin to center-pin, with 2 feet 9 inch wheels, 7 feet wheel base and pressed steel frames. The carriages are all exactly alike and contain accommodation for 16 first-class and 41 second-class passengers in each carriage, with three side doors and a passage from end to end. The first class passengers are at one end of the carriage and the driver's box, with switches, etc., is at the other. When the two carriages are coupled together to form a train, the driver's boxes are at the extreme ends and the two first-class compartments, consequently together in the middle of the train. A small door through the contiguous ends of the carriages enables the guard or attendant to pass from end to end of the train.

The motors, one at each end of the train, are controlled from either end, the driver, of course, always traveling at the front end of the train and changing ends upon arrival at a terminus, carrying with him a key without which the motors cannot be operated. In a train thus arranged one driver and one conductor constitute the train staff, the guard as well as the driver having it in his power to cut off the current from the motors and to apply the brakes.

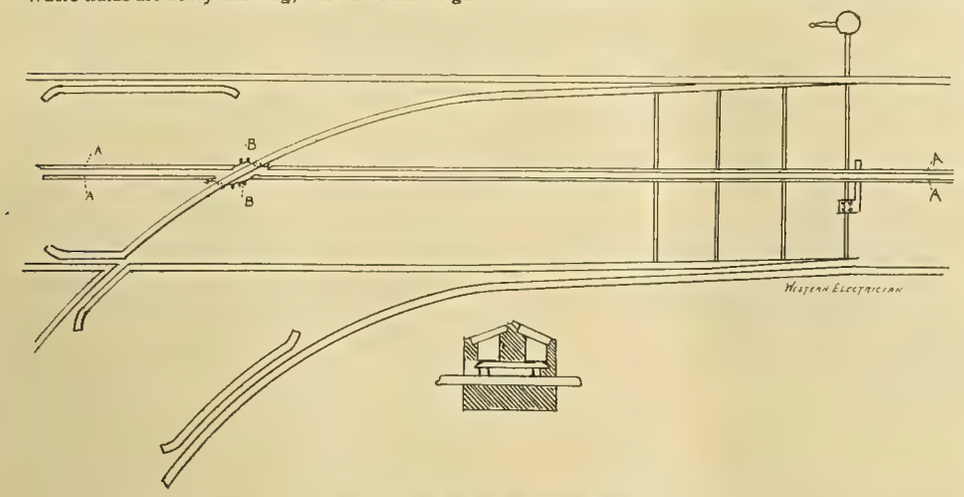

FIG. 3. DIFFERENTIAL BLOCK SYSTEM.

The trains are fitted with the Westinghouse automatic brake, deriving its supply of compressed air from a reservoir on the train, the reservoir having a capacity sufficient for two complete journeys, and being recharged each journey from a receiver placed at the terminus at the north end of the line. This system of working the brakes was previously applied by Mr. Greathead and found to work well on the City & South London railway, and has answered equally well here. The air compressors are in this case worked by a small electric motor with a gas engine in reserve; and pending the completion of the northern extension, the compressed air is conveyed a distance of about three-quarters of a mile through one of the gas tube rails of the parapet to the present northern terminus at Alexandra Dock station. A hand brake is also provided at each end of the train. The carriages are lighted by 32 candle power incandescent lamps connected with the working current, and the stations are lighted by similar lamps connected with a battery of accumulators placed under one of the platforms at each station. These batteries are in duplicate and are charged in series by the main generating dynamos.

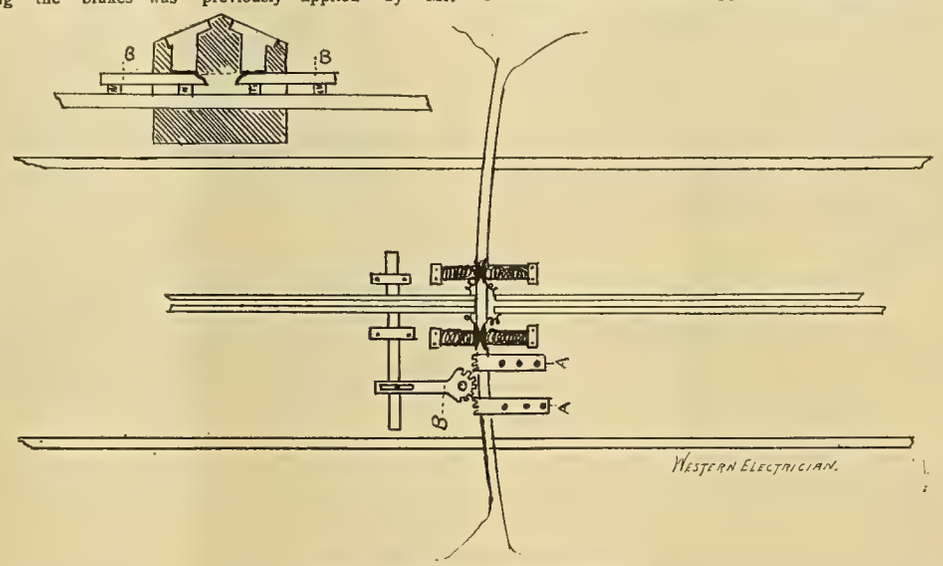

FIG. 4. DIFFERENTIAL BLOCK SYSTEM.

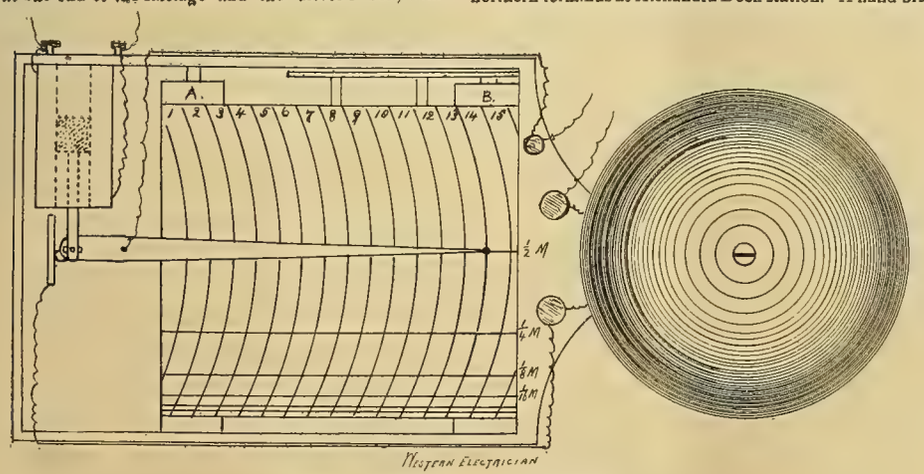

FIG. 5. DIFFERENTIAL BLOCK SYSTEM.

The coal is tipped direct from the railway trucks into large hoppers placed over the boilers, and is distributed by a conveyor to the shoots of the Vicars' mechanical stokers with which the furnaces are fitted. There is thus no handling of the coal. Water from the adjacent dock is used for condensing, and the town water for the boilers.

The boilers are of the double flue Lancashire type, with cross tubes; they are of steel, six in number, each eight feet in diameter by 30 feet long, with a working pressure of 120 pounds per square inch, and Green economizers in duplicate are fixed in the main flues. The steam and feed-pipe ranges are also in duplicate. The engines are four in number, each consisting of a pair of horizontal compound condensing engines, built by Messrs. Musgrave & Co., of Bolton, who contracted with the Electric Construction corporation to supply the engines and boilers complete, and with the company to erect the chimney shaft 165 feet high, foundations of boilers, engines, etc. The high pressure cylinders are 15½ inches and the low pressure 31 inches in diameter, with a stroke of 36 inches fitted with Corliss valves driven by Tripp gear, acted on directly by the governor. Each engine will develop 400 indicated horse power at 100 revolutions per minute, with 120 pounds boiler pressure. All the engines exhaust to one condenser of the tubular surface type. The centrifugal circulating pump and air pumps are driven by a Musgrave "no dead center" vertical compound engine, and the condensing plant is in duplicate.

Each engine drives an Elwell-Parker dynamo, from which the current is conveyed north and south along each line of the railway by the steel conductor already described. Hinged collectors of cast iron, sliding upon this conductor, the top surface of which is about thseequarters of an inch higher than rail level allow the current, when required to pass through the motors and to return by the wheels and the rails to the dynamos. At the crossings the conductor is bent to form wings parallel to the rail to be crossed, in the same way as is usually done at rail crossings.

The question of the relative economy of the working of steam and electric locomotives is of great interest at the present time. The nearest approach of the Electric Overhead railway at Liverpool seems to be the elevated railways in New York, worked by steam locomotives. In each case the trains are comparatively light, though the New York trains are heavier than those at present running on the Liverpool line, and in each case the stations are on an average about one-third of a mile apart. In 1889 an experiment was made upon one of the New York lines to determine the possibility and the cost of working by electricity. The results of this experiment, with a continuous current system of electric traction, were used with considerable effect in the Parliamentary Committee rooms on behalf of the Metropolitan Railway company against the proposed Central London railway in 1890, and a description of the experiments and the results and conclusions derived from them, with details of the cost of working the steam locomotives on the Manhattan railway, was published in a paper by Lincoln Moss in October, 1890. The main conclusion arrived at was that "the cost of direct electric propulsion would be four times that of steam locomotion" on the Ninth Avenue railway.

It is not necessary now to describe in detail the arrangements and results of those experiments, but it may be interesting to mention that the New York experiments were made with a train of 53¾ tons drawn by an electric locomotive of nine tons or more over a length of 1¾ miles of line, with four intermediate and two terminal stations, and having gradients of

$$\frac{1}{100'}\ \frac{1}{70}\ \text{and}\ \frac{1}{54}\ \text{against, and}\ \frac{1}{100}$$

with the load. The average speed attained was 9.4 miles per hour, stopping at the four intermediate stations; the average power of the generating engine was 176.8 indicated horse power, and the average power applied on the railway was only 26.7 effective horse power, giving thus an efficiency of 15 per cent. as regards the indicated and effective power. Estimates were made in detail of the cost of installing and working an electrical equipment capable of dealing with the traffic on the Ninth avenue railway, about five miles long. The total arrived at was

£771,000, including 17 generating engines, each of 600 horse power, dynamos aggregating 11,000 horse power, and electric locomotives alone costing £126,000. The estimated working expenses for motive power, excluding interest on the first cost, came to £135,000 per annum, or to over 3s. per train mile.

The actual cost of the whole electrical equipment of the Liverpool Overhead railway, for six miles of line, has been little more than five per cent. of the above estimate for the Ninth avenue line of five miles, and the working expenses for motive power are about 4d. per train mile, the mileage being much below the capacity of the generating plant. With a train mileage equal to that of the Ninth avenue line the cost would not exceed 3d. per train mile. The actual average consumption of coal on the Liverpool Overhead railway is about 16 pounds per train mile for trains of about 38 tons weight, with seating capacity for 114 passengers, running at an average speed, including stops at stations of about 12 miles per hour; whereas the averages on the New York elevated railways are, as far as can be ascertained, 54 pounds of coal per train mile for trains of about 92 tons weight (including locomotives weighing 23 tons) running at an average speed, according to the official timetables, of about 12 miles per hour, including stops at stations. On the Liverpool railway, during the last half year, over 95 per cent. of the trains were punctual to time. No returns are available as to the punctuality of the New York trains. The coal used at Liverpool is bituminous small coal, while in New York it is anthracite of good quality. The New York fuel consumption includes the heating of the trains in cold weather, but on the other hand that of the Liverpool line includes the lighting of trains and stations and the working of the automatic signals. The working of the brakes is included in both cases.

It will thus be seen that, far from electric traction costing four times as much as steam locomotive traction, it is actually less expensive after full allowance is made for the difference in the weights of trains and other circumstances, in the two cases considered; and, when the mileage of the electric line increases, the difference will be still more marked in its favor.

The Liverpool empty train weighs 31 tons 2½ hundredweight, of which the electrical equipment for locomotion weighs 6 tons 7 hundredweight. With all seats occupied by passengers, the total weight is about 38 tons, 6 hundredweight, but on occasions the standing room in the train is also fully occupied, bringing the weight to perhaps 50 tons. The weight of locomotive equipment is thus about 125 lbs. per passenger, and about 20 per cent. of the total weight of the train with all seats occupied, each passenger being taken at 140 pounds weight. A comparison of these figures with those of trains on other railways using electric and steam locomotives is given in Table A:

TABLE A.

	Electric Motors.	Electric locomotives.	Steam locomotives.	
	Liverpool Overh'd Railway.	City and South London Railway.	Manhattan Railway, N. Y.	G. N'th'n Railway, Suburban Train.
	T. C. Q.	T. C. Q.	T. C. Q.	T. C. Q.
Weight of motors or locomotive	6 7 0	10 7 0	23 4 0	53 10 0
Number of passenger seats in train	114	96	240	414
Weight of motors or locomotive per passenger, in lbs	125	241	217	290
Weight of full train (all seats occupied)	T. C. Q 38 5 2	T. C. Q. 37 7 0	T. C. Q. 104 1 0	T. C. Q. 188 11 0
Weight of motors or locomotive relatively to weight of full train, without motors or locomotives, per cent	20	38	29	40
Average weight of empty carriages (without motors) per passenger seat, in lbs	487	490	615	590
Weight of full train, per passenger, in lbs	752	871	972	1,020

It need only be observed in reference to the above table that the comparison is very favorable, so far as weights are concerned, to the adoption of electric motor carriages where practicable and otherwise suitable.

In other respects also, not indicated in the above table, the advantages of the Liverpool arrangement are considerable. The weight on the driving wheels of a full train is 13 tons, 15 hundred weight, or about 36 per cent. of the whole weight of the train. Taking the minimum available adhesion at one-seventh of the weight on the driving wheels, this gives about 115 pounds per ton of train, and the motors give an equal tractive force with a current of 133 amperes. The electric locomotives of the City & South London railway, weighing 10 tons, 7 hundred weight each, give on the driving wheels 28 per cent. of the whole weight of the train similarly loaded, and an adhesion (at one-seventh of the weight) of 90 pounds per ton, where the motors give a tractive force of 100 pounds per ton, with a current of 150 amperes. For comparison with steam locomotives, the district railway trains may be taken. A train of nine coaches, weighing empty 87 tons, and seating 400 passengers, is drawn by a locomotive of 46½ tons weight, of which 35 tons 13 hundred weight is upon the driving wheels, having cylinders of 17 inches diameter and 24-inch stroke, and driving wheels, when new, of 5 feet, 9½ inches diameter. The weight on the driving wheels is therefore 19 per cent. of the full weight of the train; and taking again one-seventh of this, the available adhesion is 61 pounds per ton of train. With 120 pounds mean effective pressure in the cylinders, the tractive force, allowing for the friction of the engine, would be about 70 pounds per ton of train. It should be observed that the tractive force given above for the electric motors is available only so long as the stated currents pass through the motors, and that, as the speed increases, the current and, to a corresponding extent, the tractive force, are reduced.

These comparative figures are shown in the following table:

TABLE B.

	Liverpool Overhead Railway.			City and South London Railway.			District Railway.		
	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.
Weight of train (all seats occupied)	38	5	2	37	7	0	157	10	0
Weight on driving wheels	13	15	0	10	7	0	35	13	0
Weight on driving wheels per cent. of train weight		36			28			19	
Adhesion at one-seventh of weight on driving wheels, lbs. per ton of train		115			100			61	
Tractive force, lbs. per ton of train:									
Motors with 133 amperes		115							
Motors with 150 amperes		120			100				
Locomotive with 120 lbs. mean effective pressure in cylinders								71	
Maximum tractive force per ton of motors or locomotive lbs		730			307			234	

The last line of Table B brings out a strong feature of the electric motor or locomotive, viz., that, weight for weight, it is much more powerful than the ordinary steam locomotive. The latter has not only to apply, but it has also to carry the materials for and to generate the motive power. In a separate electric locomotive this advantage cannot be utilized to the same extent as is the case in the motor cars, but it is still considerable because, in the one case, the whole of the weight of the locomotive is available for adhesion, and the motors can always be relied upon to exert a tractive effort exceeding the adhesion due to their own weight and that of the frame and wheels carrying them; while, on the other hand, even in the case of tank engines, only about two-thirds of their weight is usually available for adhesion. Having regard to the large tractive force available, relatively to the weight of the train, on the Overhead railway, as shown in the table, it is not surprising that the promptness with which the trains get up speed is frequently remarked upon by passengers.

Following is an abstract from Thomas Parker's paper upon the electrical equipment:

When the Overhead Railway company in 1891 took into consideration the employment of electric traction for its trains, the Electric Construction corporation, of Wolverhampton, tendered for the equipment of the line, and secured an order for the complete installation, comprising boilers, engines, steam pipes, dynamos, rolling stock, station lighting and signals. The plant was required to run a three-minutes' service on a double line six miles in length, and to accomplish this distance in 29 minutes, including stops of half a minute at each one of the thirteen stations. Each train was to consist of two cars, each car carrying 56 passengers, and being of an estimated weight of 12 tons 10 hundredweight without motors.

To meet this service, 20 trains running at one time would be necessary, and in considering the power required at the dynamos, the subject was approached from its elementary basis. Curves were drawn to show the energy absorbed by one loaded train at every point in the whole length of the line, assuming various accelerations and intervals during which the brakes might be applied to bring the train to a standstill, the weight of a loaded train, with motors, being assumed to be 34 tons. These curves were modified and checked by the results of experience on ordinary railways, until results were obtained which would meet the service required. In most cases the stations were so near one another (in one instance under 300 yards, and in others 400 yards) that the brakes had to be applied long before the train could attain a uniform speed, the greater part of the energy supplied to the motors being expended in accelerating the motion of the train, which was required by the specification to attain a speed of 30 miles per hour, if necessary. From these curves it was an easy matter to calculate the power required for the whole service. This gave, allowing for the various electrical losses which were capable of being estimated, 1,200 to 1,400 amperes at 500 volts, which was the electrical pressure decided upon, or nearly 900 electrical horse power. This was split into three units, and to allow for one spare, it was decided to use four dynamos for the generating plant, each having a normal output of 475 amperes at 500 volts, at 420 revolutions a minute, or about 1,200 electrical horse power in all.

The main conductor is of steel, 4 square inches in section, Fig. 2, rolled in lengths of 32 feet 6 inches, and weighs about 40 pounds per lineal yard. It is supported between the main rails on wooden cross-sleepers, and rests on porcelain insulators. The insulators were designed for use with oil, but as the average leakage over the whole line is only 2 to 3 amperes, this has been thought to be an unnecessary refinement. The steel channel is not rigidly attached to the insulators in any way, and is supported by them at every 7 feet 6 inches, except where joints occur in the conductor, in which cases the insulators are 2 feet 6 inches apart. The lengths of conductor are electrically connected by flexible copper straps. There are no feeders, and the return circuit is through the rails, which are united by wrought iron bonds riveted to the web and bridging across the fish-plates. All four rails are cross-bonded at the stations, but are insulated from the structure by longitudinal sleepers. They weigh 56 pounds per lineal yard. The return circuit has thus a sectional area of approximately 22 square inches. At each station there is a cross-over road, and, in order to surmount the difficulty of carrying the charged conductor past the main rails at these points, it was broken and each end was bent parallel to the main rail for some distance on each side of it, Fig. 2 being electrically connected under the rail, and fixed ¾ inch above it. The collectors on the cars were made wide enough to bridge across the gap thus formed, without breaking the circuit.

The tractive force of each motor at the rim of the wheels 2 feet 9 inches in diameter, with 100 amperes exceeds 1,450 pounds (about 87 pounds per ton of train). The weight of each motor with its axle, but without the wheels, is 3 tons, and that of the motor truck complete is 5 tons 7 hundredweight.

That these motors will stand any stresses they are likely to be called upon to bear has been proved, and this fact has been found to be of great service in actual running; for before the drivers were properly educated to their work, they frequenty, on finding any difficulty with either motor on the train, such as brush-leads working loose, or brushes making bad contact, cut that motor out of circuit by means of a plug provided on the driving switch, and continued the traffic with one motor to the end of the line.

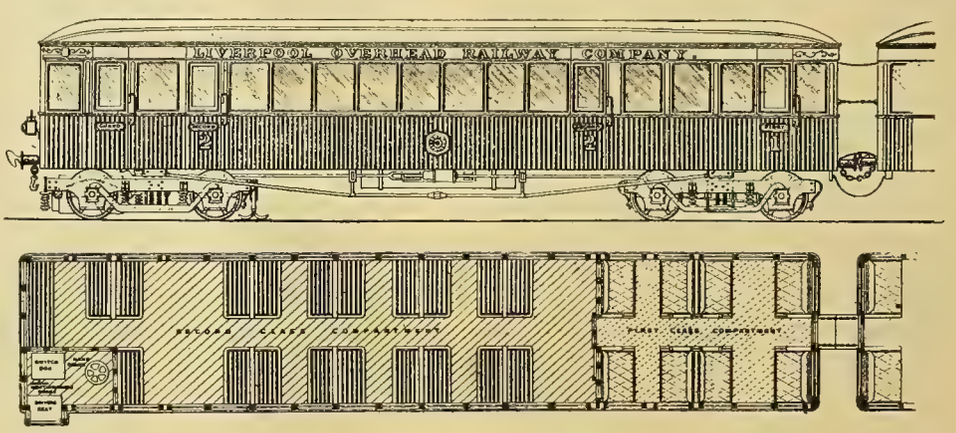

FIG. 1. LIVERPOOL OVERHEAD RAILWAY.

The efficiency of indicated horse power to electrical horse power on the line is very high, and results are given of special tests taken with carefully calibrated instruments. For this purpose No. 1 engine and dynamo were used. This engine had been running for some weeks, and was in thorough working order, the valves being carefully adjusted to give the best diagrams. The tests were taken after the engine had been running the traffic all day, when the load was transferred to a water-resistance tank. They lasted over three hours and a half, volts, amperes and speed being kept constant, and readings and diagrams taken every half hour.

The results of the tests are:

Diameter of high pressure cylinder, 15½ inches.

Diameter of low-pressure cylinder, 31 inches.

Length of stroke, 36 inches.

Mean efficiency, electrical horse power to indicated horse-power, 88 per cent.

Coal consumed, 4 032 pounds.

Total electric horse power hours, 1,195.

Coal per electrical horse power hour, 3 37 pounds.

Coal per indicated horse power (efficiency 88 per cent.), 2.96 pounds.

These results are eminently satisfactory, and are borne out by the low coal consumption in practice, of which mention will be made later.

Curves are given, Fig. 3 *a* and *b*, showing the power absorbed by a train during an experimental run covering the length of line at present open (5⅛ miles) in 24 minutes and 57 seconds, with intervals of 25 seconds stoppage at stations, or an average running speed of 15.1 miles per hour. Also during one journey performed in 23 minutes, 47 seconds, or at the rate of 16.1 miles per hour.

The particulars of these trials are:

MARCH 5, 1893. FIRST JOURNEY.

Herculaneum to Alexandra (return). One train on line.

Loaded with 8 tons (iron weights).

Total time on journey, 24 minutes, 57 seconds.

Total time current is on car, 17 minutes, 7 seconds.

Total time train is standing, 4 minutes, 37 seconds.
Total distance run, 9,030, 4 yards=5 miles, 230 yards, say 5½ miles.
Average speed while running, 15 miles per hour.
Average speed, including stops, 12.3 miles per hour.
Average current per train while running, 82.7 amperes, including stop, 67.3 amperes.
Average electrical horse power per train while running, 54.4 horse power, including stop, 44.4 electrical horse power.
Average electromotive force, 485 2 volts on car.

MARCH 5, 1893. SECOND JOURNEY.

Herculaneum to Alexandra (return). One train on line.
Loaded with 8 tons (iron weights).

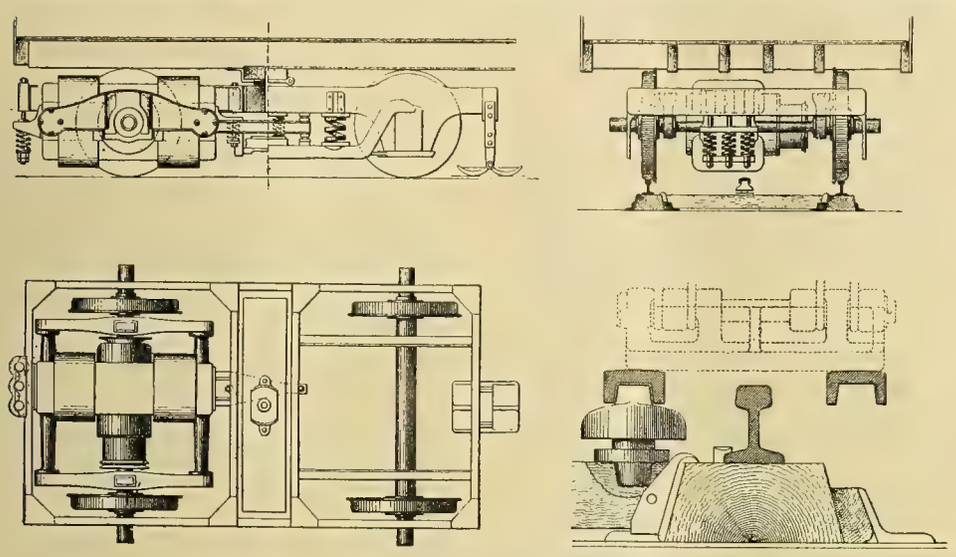

FIG. 2. LIVERPOOL OVERHEAD RAILWAY.

Total time on journey, 23 minutes, 47 seconds.
Total time current is on car, 15 minutes and 18 seconds.
Total time train is standing, 4 minutes and 49 seconds.
Total distance run, 9,030.4 yards; say 5⅛ miles.
Average speed while running, 16.1 miles per hour.
Average speed, including stops, 13 miles per hour.
Average current per train while running, 90 8 amperes, including stops, 73 amperes.
Average electrical horse power per train while running, 57.1 electrical horse power; including stops, 46 electrical horse power.
Average electromotive force on car, 484 volts.
The weight of the car complete without passengers is 15½ tons. For the test each car was loaded with 4 tons, making the total weight of the train 39 tons. The average power absorbed was 44.4 electrical horse power at 15.1 miles per hour, and 46 electrical horse power at 16 1 miles, per hour.

A comparison of the consumption of coal when the number of trains is varied is interesting. During the month of April and part of May there were seven trains on the line, giving a 10-minute service from 5:10 A. M. to 6:40 P. M. During this period the coal burned was 22 55 pounds per train-mile. This includes coal for all purposes, no deductions being made for charging the station batteries, etc.

From June to the beginning of October the train service has been as follows:

5:00 A. M. to 9:00 A. M., 8 trains in service.
9:00 A. M. to 5:30 P. M., 12 " " "
5:30 P. M. to 7:00 P M., 6 " " "
7:00 P. M to 8:30 P. M., 4 " " "

giving a five-minute service from 9:00 A. M. to 5:30 P. M.

The coal used for all purposes per train-mile has been—

	Pounds.
April	25.16
May	20.03
June	18.97
July	18.27
August	16 95
September	17.20

The figures show a continual steady decrease in fuel consumption. That for August is abnormally low, due to extra traffic during the holiday week, the car-mileage on the seventh of that month being 21 per cent. greater than usual. On that day the trains carried 48,000 passengers, each train during the middle part of the day being loaded with over three hundred people. The average weight of slack burned during the four months of June, July, August and September, inclusive of all battery charging and power at the central station and car shed, was slightly less than 17.8 pounds, or, allowing for energy expended otherwise than on the trains, it may be taken at 17 pounds per train mile.

TABLE SHOWING COAL CONSUMED PER KILOWATT HOUR, ETC.

	Kilowatts generated.	Pounds per kilowatt-hour.	Pounds per E. H. P. hour.
April	69,954	8 42	6.32
May	86,627	6.90	5.17
June	97,789	7.10	5.30
July	109,909	6.70	5.00
August	117,843	5.95	4.44
September	119,328	5.81	4.34

During four days in June, owing to the dock from which condensing water is drawn being emptied, the engines ran non-condensing, and an additional boiler was required.

The coal used is small Lancashire slack, having the following composition:

	Per cent.
Fixed carbon	70 08
Volatile hydrocarbon	16 47
Sulphur	1.92
Moisture	3 01
Ash	8.51

Its calorific value is approximately 75 per cent. of that of best Welsh coal. The price of the slack which was used until the latter part of August was 5s. 10d. per ton, but since that date, owing to the strike in the coal trade, coal has been procured from various sources at prices ranging up to 17s. 6d. per ton.

Under their agreement, the contractors engaged to run the service of trains for the Liverpool Overhead Railway company, and to supply all power, maintenance, drivers, superintendence, etc., if required, for a period of two years, for the sum of 3½d. per train mile, which was estimated upon an average daily running of 2,400 miles, At the present time only 5⅛ miles of line have been opened for traffic, and the contractors have received 4d. per train mile as, with a five minutes' service the total train mileage is necessarily decreased on the shorter line. For current to charge the station batteries 7d. per unit is received which includes the maintenance of lighting and signal plant. In the table are given figures analyzed from the actual working costs during the months of July, August and September.

The increased cost of running during August and September is fully accounted for by the item of coal, and, taking into consideration the fact that the Overhead Railway company has not employed so rapid a service as was at first anticipated, the average running per day being only about 1,350 train miles, the figures indicate most favorable results, as, even with this mileage, the trains were run at a fair profit for July and August, and it is evident that with coal at a normal value, the linecan be run at a cost within that guaranteed by the contractors.

COST OF WORKING, INCLUDING THE LIGHTING OF STATIONS AND THE SIGNALS.

	Pence per train-mile.		
	July	August.	September
Supervision	0.416	0 416	0.416
Generating station, wages	0 618	0 590	0.628
Drivers' wages	1 076	1 043	1.058
Coal	0.586	0 718	1.230
Oil, waste, grease	0.140	0 139	0.129
Water	0.010	0.013	0.015
Stores and sundries	0.019	0.105	0.115
Cleaning and repairs, etc., at the car shed: Wages	0.545	0.521	0 539
Cleaning and repairs, etc., at the car shed: Material	0.284	0.430	0 221
Total	3 727	3.975	4.351
Allowance for signals and lighting	0 286	0.271	0 276
Cost of running	3.441	3.704	4 075
Train mileage	39,250	41,430	40,640

Telephone Litigation.

A dispatch from Toledo, O., dated March 22d, states that suit will soon be commenced against the Central Union and Bell Telephone companies. The dispatch is as follows:

The largest patent suit ever filed in Toledo will be inaugurated in the United States Court here within a few days by ex-Congressman Frank Hurd. The action is to be brought by the American Electric company, incorporated to-day, against the Central Union and Bell Telephone companies. The invention involved is known as the multiple switchboard and was patented by Martin J. Carney, at that time an employe of the Central Union Telephone company. It was placed on trial in the company's Toledo office, and has since been put into use in every telephone exchange in the United States. During all these years the inventor claims he has not received a cent from the Bell company for the use of his invention. Damages for not less than $5,000,000 will be asked when the suit is filed.

Electrical Weaving.

Since the first weaver threw his shuttle, from hand to hand, across the warp threads of the primitive loom, various mechanical methods of accomplishing this motion have been devised. The latest plan, invented by Levi W. Lombard of Lynn, Mass., is essentially an electrical method, and is said to have many advantages over any other. On two horizontal rods stretched across the fabric, one just above the warp and the other just below, Mr. Lombard mounts a number of carefully insulated coils of copper wire. These coils are in circuit with a dynamo or battery, and each one on the upper rod is so connected with the one below it that the two are electrified at the same instant. By means of a commutator switch the current is made to animate these pairs separately and in regular succession. The shuttle is composed largely of iron, and hence is susceptible of magnetic attraction from the coils, and the shifting of polarity draws it first in one direction and then in the other. At the end of each journey the shuttle is held by the magnetism of the last pair of coils, and needs no buffer. Another feature of this plan is that the weight of the shuttle is sustained by the magnets, and hence does not fall upon the lower warp threads, as in other looms. The invention is said to be suited to all classes of fabrics—cotton, linen, silk and woolen.

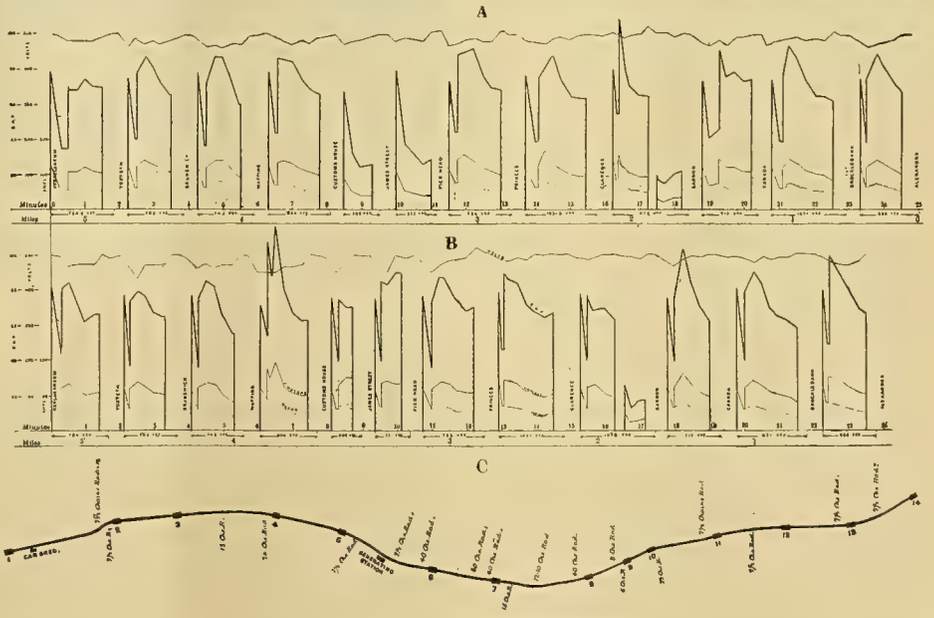

FIG. 3. LIVERPOOL OVERHEAD RAILWAY.

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HIGH WATER MARK CIRCULATION, 16,630.

IT is with mingled feelings of pride and pleasure—pride in achievement and pleasure in that success which honest, faithful work, well done, alone brings—that we present to our readers in this issue, under the title of "At High Water Mark," a short history of the founding, growth, progress, and prosperity of the WESTERN ELECTRICIAN, culminating on the occasion of the meeting of the National Electric Light association at Washington, D. C., in the publication of its issue of March 3d, comprising no less than 16,630 copies—the largest edition of an electrical journal in the world. The details of this truly great work will be found carefully outlined, showing in a striking manner just what this undertaking involved in labor, care and performance. The graphic comparisons, showing the amount of material employed, and the numerous illustrations, depicting the many departments of a great industrial-scientific newspaper will prove both interesting and instructive. The concise review of the establishing of the paper, its World's Fair work, and the production of the only real electrical daily as complete in every particular as the weekly editions, are entertaining bits of journalistic history. The matertal requirements of the West long ago demanded a paper of their own; the soil was virgin, the need pressing, and a commanding and vigorous journal is the outcome. Its policy has at all times been marked with dignity, independence, enterprise, accuracy, impartiality and fearlessness. Its ever present motto has and always will be the advancement of the electrical interests of the great West. To this end it has devoted unsparingly its best enegries and untiring labors, and to have taken part as the advancer, encourager and chronicler of that development, which stands to-day as a monument of its own magnitude, whatsoever share its influence may have had in it, is an ample reward.

As each step of progress has been marked by the mile stones of attainment in the past, so in the future the same zealous spirit of ambition to reach higher planes and achieve further triumphs will be present; to subserve the interests and promote the practical purposes of electrical science, is the object always in view.

From the distinct domain of electrical journalism the WESTERN ELECTRICIAN extends to its contemporaries of the East its best wishes for their success in their own sphere.

THE letting of the contract by Superintendent Hannan of the Public Works department of New York to the Cataract Electric company for furnishing electric power for the propulsion of boats upon the Erie Canal has been made the subject of a special legislative investigation by a joint committee appointed for that purpose. The officials who are responsible for the granting of the contract maintain that, in their opinion, such an arrangement was for the good of the state and the increase in value of the state's property. Generally speaking, however, the action of Superintendent Hannan is condemned. It is claimed that it has by no means been demonstrated that the electric trolley system of propulsion is practicable on the canals, and that experienced canal men seem to be convinced that it is not so. If it had been proved to be, those who are opposed to the late proceeding ask why should a monopoly for such a long term be given to a particular corporation without inviting offers from any other or inquiring into its responsibility or designs? Furthermore, it is urged that there is a suspicion that the company wished to get possession of the banks of the canal for a right of way through the state for purposes of a general business in supplying light and power to towns and private customers, and that it cares little about the right to propel canal boats except for the advantages incidental to it. It is significant, too, that a bill repealing the act authorizing such a contract was pending in the Legislature. There are many interests involved in this measure, and it is to be deplored that hasty action was taken, which may have a bad effect upon the enterprise.

THE official report of the February meeting of the American Institute of Electrical Engineers contains some interesting information for "outside" members, as they are termed by those who control the New York meetings. The president announced that he had received "an application from Chicago to elect a local honorary secretary so as to permit local meetings to take place." This request had not been acted upon by the council according to the rules, but the president explained that he was "very desirous that these meetings shall be held," and he asked the New York meeting to "authorize the little irregularity." Of course, the New York meeting had no right to do anything of the kind, having no authority whatever in the matter, yet at the bidding of the president it presumed to authorize an irregular act. In marked contrast with this action was the decision to postpone consideration of proposed amendments of the rules. One of the gentlemen who presumes to direct the course of the New York gatherings and outline the policy of the organization urged postponement, and in his argument admitted that he found himself in a "somewhat anomalous situation," which he explained to be "with some doubt whether these monthly meetings at New York are the Institute or whether the Institute is only the body of people convened at the annual meeting in May." It seems hardly possible that any doubt should exist at this late day in the minds of the faithful after President Houston's emphatic declaration. Yet such is the case, as shown by the official report printed in the *Transactions*. "The somewhat anomalous situation" or something else caused the members to postpone action on the rules, but not on the subject of the Chicago meeting which they "authorized." In this connection it might be well to add that the secretary's report of the proceedings in March leaves no room for doubt as to his position. Following President Houston's interpretation he says:

The 84th meeting of the Institute was held at 12 West Thirty-first street, New York city, March 21st. * * * A meeting of the Chicago members was also held simultaneously * * * at the Armour Institute.

Of course this is in keeping with the views of the majority of the New York members, but self-respecting members living outside of New York do not like the patronizing air assumed by the "Institute."

THE old controversy between street railway and telephone companies, respecting the liability of the former for damages inflicted upon the latter by reason of the interference with the telephone circuits by the railway wires, has been passed upon by the Supreme Court of Tennessee. The result is a victory for the telephone companies, the court deciding that the railway company must make good the cost of changing the telephone system so as to obviate the troubles caused by the electric railway lines. In the opinion accompanying the decision the court says:

The doctrine that reason sanctions and justice approves, as it appears to us, is that the lawful, harmless and accustomed use upon one's land, alike of water, air or electricity cannot be lawfully obstructed or impaired by injurious act of another, attended with such disturbance of natural and existing conditions and consequent loss as that caused by conduction in this case, especially when the party performing the injurious act had the power to obviate and remedy the injury or loss without greater sacrifice comparatively than is required of defendant in this case to remedy conduction. It is not material that the act is done on the premises of another than the injured party.

This decision concedes practically everything that the telephone men have claimed throughout the controversy. In the present case the amount involved was only $4,500, but the principle was one of the greatest importance to street railway men throughout the country, and the case was stubbornly contested. It was claimed by the street railway men that a victory for the telephone in this case meant to concede to it the exclusive right to the use of the earth return. This position the street railway men disputed, claiming that their right to the use of the streets was superior to that of the telephone company. The conclusions reached in this case will prove a surprise to many street railway managers.

ELSEWHERE is presented the report for the first half year's working of the Liverpool Overhead railway as well as an exhaustive description of the electrical and mechanical equipment of the road. The experiments and trials of the first six months afford very interesting subjects for the consideration of railway engineers. According to the figures presented the actual average consumption of coal on the Liverpool Overhead railway is about 16 pounds per train-mile for trains of about 38 tons weight with seating capacity for 114 passengers, running at an average speed, including stops at stations, of about 12 miles per hour; whereas the average on New York elevated railway is, as far as can be ascertained, 54 pounds of coal per train mile for trains of about 92 tons weight, including locomotives weighing 23 tons, running at an average speed of about 12 miles an hour including stops at stations. These figures are significant, and, when the differing circumstances are taken into consideration, it would seem that from the standpoint of economy alone, the elevated electric railway is in a position to successfully compete with steam railways.

The gross revenue for the half year was, approximately, $92,500, and the working expenses about $68,800, or practically 75 per cent. After paying interest, there was available for dividends sufficient to pay five per cent. on the preferred shares and one per cent. on the ordinary shares. These results are noteworthy and herald without doubt the inevitable approach of the overhead electric system for large cities. It is to be hoped that the companies building elevated roads in this country, and who are hesitating when the subject of motive power is encountered, will thoroughly study the facts compiled by the constructing engineers of the Liverpool Overhead railway. No more felicitous time could have been chosen for the publication of these figures, as far as Chicago is concerned, than the present. With two new elevated roads hesitating between the adoption of electricity and steam, and two steam roads in operation, seeking for a more economical motive power, this city is in a condition to digest with care the papers of Messrs. Greathead, Fox and Parker. And no city is more alive to the possibilities of the elevated electric road than this, for it has had an example of the fine and reliable service possible from such a system in the Intramural road at the fair. It is to be hoped that if a smokeless and a cinderless road does not appeal strongly to the managers of Chicago's existing and prospective schemes of rapid transit, that the vision of increased dividends will have a greater incentive than considerations of public approval.

Death of J. L. Barclay.

The numerous friends of Jacob Livingston Barclay of Chicago will learn with regret of his sudden death at Pittsfield, Mass., of appendicitis, on March 26th. Mr. Barclay had gone to Pittsfield to attend to some electrical business and was there stricken with that disease. Dr. W. T. Bull, the famous New York surgeon, was immediately sent for. He performed the usual operation, and the patient was apparently in a fair way to recovery when blood poisoning set in.

Mr. Barclay had long been known as one of the most successful salesmen in the electrical business. His first venture in this line was with Holmes, Booth & Haydens in whose service he remained for a long period, making an excellent record as a wire salesman.

While still representing that company, Mr. Barclay took the western agency of the Sprague Electric Railway & Motor company. For a long period nothing but stationery motors were sold, but after the Richmond Electric railway experiments Mr. Barclay was as successful with his street railway business as he had been in the wire business.

On the absorption by the Edison company of the Sprague interests, Mr. Barclay took the western management of the railway department of the Westinghouse Electric & Manufacturing company, where he remained until about a year ago. When the Walker Manufacturing company of Cleveland decided to embark in the electrical business, Mr. Barclay was selected as the western representative. He had but just completed the fitting up of very fine offices in the Monadnock building, Chicago, and his sudden taking off just on the eve of what he and others believed would prove a great success, will be very much regreted by all. Mr. Barclay was an Englishman by birth, and was about 35 years of age. He had been closely identified with the development of the electric railway business in the West, and had been generally successful. Mr. Barclay's wife and two children survive him. His remains will be brought to Chicago for burial.

An Adventure in an Electric Fountain.

All who were conversant with the manner of operating the electric fountains at the World's Fair will be interested in the story given below of a queer mishap at the Midwinter Fair. The Mr. Dorr referred to is F. H. Dorr, who was in charge of the fountains at Chicago. The incident is thus related by the *San Francisco Examiner* of March 2d:

The rain had a dampening effect on the electric fountain at the fair last night. The gorgeous sprays, in view of the fact that they consist merely of water with colored shafts of light projected into their interior, might have stood the dampening if it had not been accompanied by a gale of wind.

Against the wind the sprays rebelled, and after refusing to give a well-regulated exhibition they desiccated themselves into such minute particles that they were carried away from the basin spread to receive them. Mingling their tears with the natural downpour, a river was formed that speedily cut itself a deep, wide channel down the slope of the soft loam forming the bank of the court. This channel ended at the mouth of the boarded tunnel leading into the spacious chamber under the the fountain and selected the tunnel as the repository for all the tons of earth and gallons of water that coursed down it.

In the chamber under the fountain are located the colored lenses and lights by which the effulgence, iridescence, wheat fields, rainbows and other pretty things are produced in the sprays. They are operated by Mr. Dorr, of Chicago and three assistants, who are secured from curious intrusion by a stout door which swings from the inside out at the end of the chamber end of the tunnel. When the fountain began to play its first piece last night the rain had had no loosening effect on the slope above the tunnel. When the wind wafted sprays commenced to desert the receptacle prepared for them, the damage was set on foot, and the torrent roared into the tunnel. Mr. Dorr and his assistants were wholly unconscious of the plot and went through the programme just as if they were not being entombed alive. That is about what it amounted to, for by the time the fountain's play ceased the tunnel floor was buried grave deep in the soil, washed down by the torrent, and the end of it nearest the chamber was a lake two feet deep.

The first man who tried to open the door couldn't, and for a short time it looked as though there were no help for a night in the cavern. Outside the storm was roaring so that no appeals for aid could be heard, and in desperation the party assaulted the door in concert. The soft earth gave a little, and with the first yielding of the door all hands were in danger of drowning in the flood that rushed in upon them.

When the water drained off the door yielded a little farther and there was a glimmering hope that became a reality when a chivalrous shoveler came to the rescue and cleared away sufficient debris to permit escape.

For fear of another entombment the second "act" of the fountain was dispensed with.

On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp.[1]

By Prof. William A. Anthony.

Part I.

Since the issue of Edison's incandescent lamp patent in 1880, it has been the generally accepted theory that the principal cause of the decay of the filament of an incandescent lamp other than oxidation was the mechanical action of the small amount of gas remaining in the chamber, wearing away the filament by the attrition due to the air currents, or, as Edison called it, "air washing." Electrical forces are also supposed to have some effect, carrying the carbon from the filament to the walls of the chamber. The perfection of the electric lamp upon this view was to be sought in the direction of a higher vacuum, and more firm and solid carbons with a smoother surface. Improvements in carbons have done much to improve the lamp. As carbons are now made—built up by deposit from a hydro-carbon vapor—every interstice is filled and the surface becomes almost as smooth as, and has almost the appearance of polished steel. Such a carbon withstands well the "air washing" effect of the residual gases, and the life of the lamp at a given temperature is greatly increased. But as it is greater economy, up to a certain point, to increase the temperature and save energy, than to keep the temperature down and save lamps, temperatures have been increased as carbons have been improved,

J. L. BARCLAY.

and efficiencies have been raised until, in new lamps at least, a candle power is obtained from less than three watts, instead of four or more. But with these higher efficiencies comes a new cause of deterioration not so apparent in the low temperature lamps, the blackening of the bulb and consequent loss of transparency and decline in candle power. When I see incandescent lamps hung for use, I involuntarily find myself looking for blackened lamps, and it is no uncommon thing to see those through which objects look dim. Sometimes I see lamps so black that they would do for smoked glass in viewing an eclipse of the sun. I have taken down such lamps and measured their candle power and efficiency. Very often they run as low as ten candles and six or seven watts per candle at their normal voltage, and I have found lamps below six candles and ten watts per candle. The customer was still using these and had not "kicked" so far as I know, though he was sure he was not getting the light he did at the beginning. Generally, he does not know what the matter is, thinks, perhaps, the company is, parsimonious with the "electricity," but hasn't said much, "because he doesn't want to be all the time making a row." Of course, the illuminating company cannot be expected to go around and hunt up such lamps and change them; so, as long as the customer does not complain, but pays for his six or ten candles at the price of sixteen, the old blackened lamps remain on the circuit until they burn out. Since such lamps increase in resistance they take less and less current, and the older and more feeble they become, the more tenacious they are of life. It is no uncommon thing to hear of such lamps that have lived through six, eight or ten thousand hours of active service, when, probably, not one of them was able to do its full duty, and should have been placed on the retired list, at three hundred hours.

1. Read before the American Institute of Electrical Engineers, March 21, 1894

Now the question arises, is there no way to preserve the illuminating power of the lamp throughout the life of the filament? Surely a long-lived filament is of little value if it fails to give a reasonable light after two or three hundred hours.

Loss of candle power might be avoided by lowering the temperature and with it the initial efficiency of the lamp, but this is an improvement in the wrong direction, although I am sure the customers, whether they pay for their electric energy by the meter or by the year per lamp, would be the gainers if they were furnished with lamps of lower initial efficiency, unless their lamps are changed oftener than is usually done. The present high efficiency lamp would do very well if there were any way to insure its retirement from the service when its legitimate usefulness was passed. The ideal lamp would be one that, while giving a high efficiency and a reasonable life, should die by the rupture of its filament while still doing its best work.

About a year ago John Waring began experimenting upon the effects of heavy gases in the lamp chamber, using principally the vapor of bromine as obtained from the liquid bromine of commerce. It is not necessary to describe in detail the various experiments. The final result reached was that, when bromine vapor was present in the chamber in proper quantity, the lamp, as compared with a vacuum lamp, could be run at a higher efficiency without blackening or increase of resistance, therefore without loss of candle power and with an increase in its useful life. These facts were abundantly demonstrated by numerous experiments. Below are the results of some experiments that I myself recently performed. I had made a number of 50-volt 16-candle lamps. Half of these were exhausted in the usual way as vacuum lamps. The others were made into bromine lamps after the method employed in the Waring factory. The lamps were all "volted," then four of each were run for three and a half hours at 65 volts, and for one and a half hours a 170 volts pressures—15 and 20 volts in excess of the normal. Two of the bromine lamps broke at the end of the run. The results are given in the following table:

TABLE I.

	Lamps, New.			After 5 Hours at 65 and 70 Volts.		
	Volts.	C. P.	Current	C. P.	Current	
1	49	16	26	9.4	24	Vacuum Lamps.
2	49.6	16	26	10.3	24.6	
3	49	16	26	10.6	24.8	
4	49.2	16	26	9.8	24.8	
5	49.8	16	27	Broken	....	Bromine Lamps.
6	48.8	16	26.5	15.5	26.2	
7	49	16	27	15.1	27.2	
8	50	10	26.5	Broken	....	

Note. Vacuum lamps blackened. Bromine lamps not blackened.

Comparing the two kinds of lamps, it is seen that all the vacuum lamps had fallen more than one-third in candle power while the bromine lamps fell only five per cent. The current in the vacuum lamps had also diminished, showing an increase in resistance of the filaments of over five per cent.

Two others of the same lot of 50-volt lamps, one vacuum and one bromine, were run for five minutes at 90 volts, at which pressure the light was of a dazzling whiteness. The results are given below.

TABLE II.

	Lamps, New.			After 5 Minutes at 90 Volts.		
	Volts.	C. P.	Current	C. P.	Current	
Vacuum.....	48.2	16	26	6 9	25	Greatly Blacken'd
Bromine.....	51	16	27	12.9	26.1	Not Blacken'd

In this experiment also, the vacuum lamp shows a very great loss in candle power as compared to the bromine.

It may be said that these experiments were performed under abnormal conditions. They were, to save time. But if the bromine will, when the filament is carried to such an abnormal incandescence, preserve to such a marked degree the illuminating power of the lamp, so much the more should it do so when the incandesence is normal.

But to remove any doubt as to the effect under normal conditions I have obtained from Mr. Waring the results of a life test in progress at the Waring factory, and with his permission I embody them in this paper. The results as furnished me give the individual readings for eight vacuum and eight bromine lamps all identical in material and construction up to the point of exhausting the bulbs, when eight of the lamps were taken at random to be exhausted as vacuum lamps, and the remaining eight filled with bromine vapor in accordance with the regular process pursued in the manufacture of the "Novak" lamp.

As these lamps all had similar filaments, the bromine lamps would, if run at the same candle power, have been less efficient at the start than the vacuum lamps. The bromine lamps were, therefore, "volted" for 28 candle power and the vacuum lamps for 25 candle power, and each lamp marked with its appropriate voltage. The bromine lamps varied from 52.4 to 55.8 volts, and the vacuum lamps from 50.5 to 52 volts. During the run the pressure was maintained for the bromine lamps as 54.15; for the vacuum lamps at 51 3 At approximately 200, 400 and 600 hours from the beginning, the candle power of each lamp was measured at its marked voltage. From the in-

dividual readings furnished me, I have computed the mean values which are given in the table below:

TABLE III.

LIFE TEST OF 8 VACUUM AND 8 BROMINE LAMPS.

	Mean of 8 Lamps at 0 Hours.			Mean of 8 Lamps at 210 Hours.			Mean of 7 Lamps Remaining at 400 Hours.			Mean of 6 Lamps Remaining at 625 Hours.[1]		
	Volts.	Amp.	C. P.	Volts.	Amp.	C. P.	Volts.	Amp.	C. P.	Volts.	Amp.	C. P.
Vacuum....	51.35	1.6888	25	51.35	1.739	22.31	51.26	1.704	20.17	51.33	[illegible]	[illegible]
	8 Lamps.			7 Lamps Remaining.			5 Lamps Remaining.			3 Lamps Remaining.		
Bromine....	54.16	1.768	28	54.36	1.816	28.26	54.92	1.792	29.24	55.37	1.357	[illegible]

1 One of the 6 vacuum lamps has a very bright spot on the filament, and can only last a few hours longer.

The efficiencies in watts per candle are as follows:

TABLE IV.

	0 Hours.	210 Hours.	400 Hours.	625 Hours.
Vacuum.........	3.469	3.99	4.33	4.8
Bromine........	3.421	3.49	3.41	3.54

What is the teaching of these results? Of the bromine lamps one had failed in less than 200 hours, two more in less than 400 hours, and two more, or five in all, before the end of the test at 625 hours, but the candle powers of the lamps still doing service were even higher than at the beginning. At 400 hours there had been no less efficiency. At 600 hours the efficiency had only fallen about 3 per cent., and even this was partly due to the fact that these three remaining lamps were, at the start, below the average efficiency. The vacuum lamps on the contrary had failed in candle power nearly 20 per cent. at 400 hours, and 27 per cent. at 625 hours. In efficiency they had dropped from 3 47 at the start, to 4.33 at 400, and 4.8 at 625 hours.

Although only one lamp had failed, those vacuum lamps were all practically dead at 400 hours, and in comparing their useful life with that of the bromine lamps, they should so be considered. But in whatever way the comparison is made, the bromine lamps in this test will appear as the better lamps, and yet up to the point of exhausting the chamber the bromine and vacuum lamps were precisely alike.

These results do not accord with the generally accepted belief as to the effect of gas in the lamp chamber. Again and again I have been asked in reference to the claims for the "Novak" lamp:—"Is it true that they maintain their candle power?" and, second, with considerable skepticism thrown into it:—"Well, how do you account for it?" This means that I must submit overwhelming proof of the alleged facts, or I must account for them. I do not object to this. It would be my own position in a similar case.

I remember once, some years ago, an inventor of a new dynamo asked me to come and see it, and give him an opinion of it. When I reached his shop he, unfortunately, could not show it in operation, but he assured me that his dynamo was a most wonderful machine, several times as efficient as any other known. He told me that, running it by means of a little engine, that could not by any possibility give more than two horse power, and which also ran his shop, he was able to run thirty-two Edison 16 candle power lamps of the old eight-to-the-horse-power type, to full incandescence. It seemed to me that it must be a wonderful dynamo to develop four horse power from two. I asked him how he accounted for it. He could not explain it very clearly, at least I could not get the force of his explanation, and, though I saw the engine, and the dynamo, and the lamps, I expect I came away somewhat skeptical as to the performance of that machine.

Now I hope to be able to convince you before you go away to-night that the facts claimed for these bromine lamps are fully in accord with other known facts, even if they do not seem to accord with previous theories as to the action of gases in the lamp chamber.

I may say that the fact that there is less blackening in a lamp that contains some residual gas is no new discovery. It was noted early in the history of the incandescent lamp. Edison noted it and made it the subject of a patent in 1883. Bernard S. Proctor, in 1883, states that the manufacturers of Swan lamps had found "that these carbon deposits which occur when a lamp is overheated occur even more in lamps with the highest vacua than in those less perfectly exhausted."[1]

Other observations pointing in the same direction have been made from time to time, although the true bearing of the observations do not seem to have been recognized. Prof. Thomas, in a paper read before this Institute detailing the results of his life tests of various makes of incandescent lamps,[2] states that he found the lamps exhausted by metallic pumps to blacken less than those exhausted by mercury pumps.

Prof. Thomas suggests no explanation, but various references to his paper seem to take it for granted that the difference is due to the presence of mercurial vapor in the lamps exhausted by mercury pumps. E. E. Cary in a note "On the Blackening of Incandescent Lamps," takes this view.[3]

I do not know of any foundation for the belief that mercury vapor causes the blackening, or helps to cause it. So far as I know no one has ever demonstrated that mercury vapor exists to any extent in the chamber of an incandescent lamp. It cannot exist at a pressure greater than about 1-15,000th of an atmosphere unless the temperature of the mercury is much above that of the pump room.

Since the degree of vacuum possible by means of a mercury pump, is limited by the tension of the mercury vapor, and since, as long as any gas is being removed, the flow is from the lamps through long narrow passages toward the pump, I do not see how it is possible for vapor of mercury in any quantity to find its way back from the pump to the lamp. I believe, notwithstanding Mr. Cary's statements in the article cited as to the degree of vacuum obtained by mechanical pumps, that the greater freedom from blackening in lamps exhausted by them, is due to the poorer vacuum, and that this is another case of blackening prevented by the presence of an inert gaseous atmosphere within the lamp chamber.

Now let us consider the question: Why should the presence of a gas lessen the blackening of the lamp? To answer this question we must first consider the cause of the blackening.

The coating consists wholly of carbon, no metal deposit ever being found except when the filament breaks near its junction with the leading-in wires, so forming an arc which vaporizes the metal, the vapor formed depositing upon the glass as a metallic coating. But as this coating is only formed at the moment of rupture of the filament, it has nothing to do with the true "age-coating" with which we are dealing.

The carbon coating is uniformly distributed within the bulb.

The carbon forming the coating must come from the filament.[4] Is it taken from it by chemical action? Is it worn off by attrition by the residual gas? Is it thrown off by electrical action? Is it thrown off as a vapor in consequence of the high temperature?

Explanations of the phenomena have been based upon all these different agencies.

It has been supposed that the oxygen remaining in the chamber, combined the carbon forming carbon monoxide or dioxide which was dissociated by contact with the cold glass, leaving the carbon as a deposit, while the oxygen returned to the filament to combine with more carbon, and so on until the filament was destroyed. This, of course, cannot be, since the oxygen compounds of carbon are only dissociated at a very high temperature, far above that at which they form, and, therefore, far above the temperature of the filament.

The suggestion that the carbon is worn off the filament by "air-washing" and settles upon the walls of the chamber, never seemed to me to account for the continuity and uniformity of the coating, and in the light of the facts demonstrated by the experiments I have described to-night, the theory of blackening by "air washing" is untenable, since there is less blackening while there must be more air-washing in the bromine lamps.

The carbon must then be thrown off from the filament by the electrical action, or by the high temperature, or by both combined. In either case it is gaseous carbon, which will return to solid form wherever it comes in contact with matter at a sufficiently low temperature to condense it. This it will surely do when it reaches the walls of the chamber, if not before. I repeat that, whether the high temperature or the difference of electrical potential is the cause of the separation of the carbon from the filament; the carbon that leaves the filament is gaseous carbon. I expect this statement will be questioned, and I, therefore, state as fully as possible the considerations that lead to this conclusion. It is objected that carbon cannot be vaporized except at enormously high temperatures. Also, that in the lamp the particles of carbon are projected in straight lines which shows the action to be a "Crookes' tube effect." What is a Crookes' tube effect? It is a radiation of the molecules of a highly attenuated gas from one of the electrodes of a vacuum tube, the exciting cause being a great difference of electrical potential. Possibly, as claimed by Schuster and others, these gaseous molecules are separated by the electrical forces into still smaller elements, but whether they are or not, will make no difference with the bearing of these phenomena upon the question under consideration.

In an ordinary vaccum tube, the passage of the electric discharge produces a light extending from electrode to electrode wherever these may be placed. As the vacuum is improved, a dark space will appear around the negative electrode. Apparently the molecules are repelled so strongly that they are able to drive back the body of the gas to a certain distance, but the inevitable collisions finally take up their rectilinear motion and convert it into the vibratory motion of luminosity. As the vacuum is still further improved, the dark space becomes wider and wider, until it reaches the walls of the tube; the molecules, finding no insurmountable obstruction in their path, continue their rectilinear motion until stopped by the walls, where the impact produces a phosphorescent light. An obstruction within the tube intercepts the molecules in whose path it falls, and casts a shadow upon the walls beyond, demonstrating the rectilinear motion. The rectilinear motion can also be demonstrated in many other ways, But what does the rectilinear motion indicate? Nothing, except that the molecules have been projected through a space from which all obstructions have been carefully removed. I said all obstructions, but that is not quite true. There are still millions upon millions of molecules in the most perfect vacuum in our power to make. The flying molecules, projected from the negative electrode must make their path through these, and they can only do so when projected with considerable force. For the success of these experiments a great potential difference is necessary—a potential difference measured by tens of thousands of volts—much greater than is needed for producing the phenomena of the ordinary vacuum tubes.

But, for the rectilinear motion and all the phenomena dependent upon it, we need only a sufficient propelling force, and a space sufficiently free from obstructions. The propelling force need not be electrical, and the rectilinear motion *per se* is no sufficient evidence that electrical force was the exciting cause.

In the old Edison lamps the filament was copper-plated to the platinum wires. When a break in the filament occurred near the junction, the arc evaporized the copper and covered the bulb with a coating of metallic copper, except that a line of clean glass was often left on the side opposite the break, the line being the shadow of the unbroken leg of the filament. This is described by Dr. J. A. Fleming,[1] who says that he has never seen this shadow except in the copper deposit, that it is never seen in the deposit of carbon. To quote his words: "Hence there must be some essential difference between the vaporization of the carbon and that of the copper. The carbon deposit resembles more the condensation of a vapor and is uniformly distributed, but the copper deposit exhibits the character of a molecular radiation or shower taking place from a certain point." He adds: "The whole phenomenon calls at once to mind the beautiful researches of Mr. Crookes with vacuum tubes. Here, however, we are dealing not with an induction coil discharge, but with a comparatively low potential." Let us analyze the phenomenon. The filament breaks at the copper junction, and an electric arc is formed, in which copper is vaporized with comparative ease. A large volume of copper vapor is formed almost instantaneously in a space almost devoid of other matter. The sudden expansion of that vapor is sufficient cause for the projection of the molecules in straight lines to the walls of the chamber. It is not necessary to assume any refined electrical forces to account for the rectilinear path. The plain old-fashioned, unpretentious vapor "tension" that bursts our steam boilers is all-sufficient to account for this rectilinear projection across the lamp bulb, when there is nothing in the way.

I might quote many references to show that the carbon deposit never shows a shadow, and Mr. Proctor in the note already cited, states that a platinum deposit formed under precisely the same conditions as the copper deposit described above, never shows the shadow. This, no doubt, is due to the much lower tension of the platinum vapor produced at the temperature of the electric arc. The so-called Edison effect, which consists in a derived current through an outside circuit between one of the terminals of the lamp and an idle pole placed between the two legs of the filament, has been held to demonstrate a rectilinear movement of the gaseous matter within the bulb. W. H. Preece[2] in a paper read before the Society of Telegraph Engineers and Electricians describes experiments which he claims prove the rectilinear character of the motion, but either there is some error in the publication of his experiments, or they do not bear out his conclusions. The paper records the details of a number of experiments. In experiment 6, the idle pole was placed in a long tube attached to the lamp bulb opposite the filament near the bend, and extending in a direct line from the filament. At a very high incandescence a very feeble current was detected.

In experiment 7, the idle pole was in a tube sealed to the lamp bulb at the top, and then bent at a right angle so that the gaseous molecules which carry the current would have to turn a right angle to reach the idle pole. The current developed was nearly the same as in experiment 6, showing that the molecules may turn a right angle. This effect has been relied on more than any other, perhaps, as demonstrating that the carrying of the carbon from the filament to the walls is a "Crookes' tube effect," but it only shows that an electric current flows through the gas within the chamber. It does not show that the vehicle is carbon in vapor or in any other form. Indeed, the carrying of a current through a gas seems to be an electrolytic action, the molecules of the gas being separated into positive and negative ions, which convey the

1. *The Electrician*, London, vol. ix., p 603.
2. *Transactions*, vol. ix., p. 271.
3. *Elec. Eng.* vol. xiv., p. 118.
4. See Age-coating in Incandescent Lamps. Prof. E. L. Nichols. *Am. Jour. of Science*, xiv., p. 277.

1. The *Electrician*, London, xi., p 65.
2. The *Electrician*, London, xiv., p 436.

current exactly as in a liquid electrolyte. I cannot see that the fact that a current is carried from the positive to the negative heel of the filament, explains the deposit of carbon. Even if it is carbon vapor that carries the current, the fact that no current is apparent except at high incandescence would indicate that at a lower incandescence there was too little vapor. But whether it is carbon vapor that carries the current or not, and whether the motion is in right lines or not, I do not see that this experiment has any bearing upon the formation of the carbon deposit on the walls of the chamber. As I have said before, I attach no significance whatever to a motion in right lines. There is nothing peculiar or mysterious about it. Newton's first law says: "Every body continues in its state of rest or motion in a straight line, except in-so far as it may be compelled by force to change that state." All you want is a force to put your molecules in motion, and then keep everything else out of the way and they will move in straight lines. All that the rectilinear motion demonstrates is the absence of interfering forces; it does not in any way indicate the character of the force that imparted the motion. We must look farther in order to determine that. Probably in the Crookes' tubes the force that projects the molecules is largely electrical repulsion, but even here it is open to question. We know that under suitable conditions the material of the electrode is volatilized and the vapor deposited on the walls of the chamber or other surface within it. Prof. Wright, some years ago[1], investigated the formation of these coatings and produced in this way beautiful metallic mirrors. Prof. Crookes, in a paper read before the Royal Society[2], June 11, 1891, upon "Electrical Evaporation," describes experiments to determine the increase in the amount of vapor formed under the influence of the electric discharge, as compared with that produced by heat alone at the same temperature. Water shows a decided increase in evaporation when connected to the negative pole of the coil, and metals vaporize at temperatures at which they would not under ordinary conditions vaporize at all.

Prof. Wright, in a private letter to me, states that to obtain his metallic mirror deposits, it was necessary to use a small wire, one-fourth of a millimetre or so in diameter, for the electrode, in order to concentrate the electric action. This was frequently heated red hot. The best vacuum for the purpose was $\frac{1}{300}$ to $\frac{1}{600}$ of an atmosphere. With a higher vacuum, the metallic vapor spread out and deposited all around on the vessel instead of being confined to the object to be covered. With the proper vacuum, and a coil capable of giving a spark of four or five centimeters in length, the discharge near the electrode is dense vapor, which gives usually the characteristic metallic spectrum, and in this the surface to be coated must be placed. If placed too far from the electrode the deposit is sooty. In this experiment the electric energy vaporizes the metal partly by raising the temperature of the electrode, and partly by the direct action of electric forces. The vapor formed is hot enough, that is, the molecules separated have motion enough to give the light required for the characteristic spectrum. The tension of the vapor is sufficient to force back the gas, and almost exclude it from the space near the electrode, farther away the vapor mixes with the cooler gas, the vapor molecules give up to the gaseous molecules some of their motion, and then coalesce into a metallic dust that gives a sooty deposit on a surface in that region.

The case is exactly that of the vapor issuing from a tea kettle under atmospheric pressure. The vapor forces back the air and at a short distance from the spout is pure aqueous vapor. A little farther away it mixed with the cool air and condenses into a cloud of liquid particles.

But in all these cases where evaporation is aided by electrical forces, the results are obtained by the use of great differences of potential—thousands of volts; while in the incandescent lamp the difference is never much over one hundred volts.

1. *Am. Jour. of Sci.*, xiii, 40, and xiv, 169.
2. *The Electrician* (London), xxvii, 197.

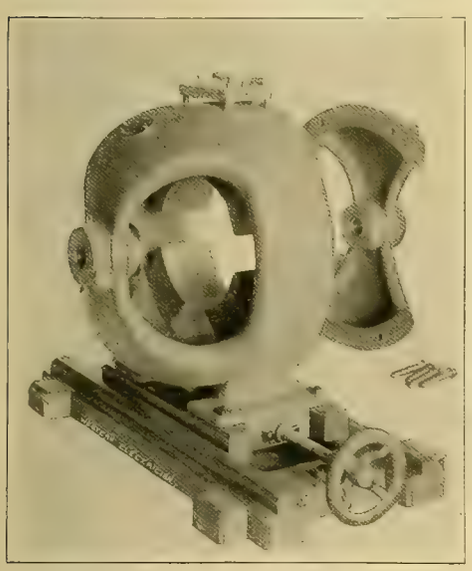


FIG. 1. A SUBSTANTIAL MULTIPOLAR DYNAMO.

And, moreover, all incandescent lamps, whether made for 110, 50, 30, or 7½ volts, blacken when run at an abnormal voltage. The blackening depends upon the temperature of the filament, and not upon the absolute potential difference in the lamp. Surely, if electrical forces played any part in the vaporation of the carbon, the effect should be greater in a 110 than in a 7½ or even a 50 volt lamp.

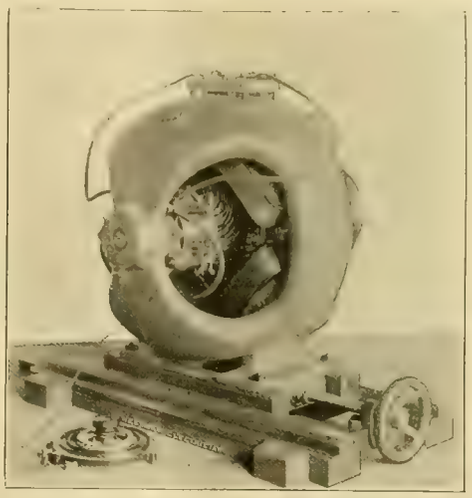


FIG. 3. A SUBSTANTIAL MULTIPOLAR DYNAMO.

A Substantial Multipolar Dynamo.

An example of the careful attention now being paid to the first cost of electrical machinery, will be found in the apparatus built by the Gibbs Electric company of Milwaukee, Wis., and described herewith. It will be noted in the illustration of the frame, Fig. 1, that the machine is of the multipolar type, circular in form and having inwardly projecting pole pieces. The frame is cast integral with the pole pieces and bearing arms on the front end. The rear end bearing is separate and is bolted to the frame, and is made with a tongue and groove fit to secure absolute centrality. In the bearing arms are inserted false boxes carrying the ball and socket bearings. These bearings are self-aligning and self-oiling. On the larger sizes the frame is split in the center to allow of easier removal of the armature, which is necessary on machines of over eight kilowatts capacity. The appearance, however, is changed in no respect, it being the policy of the Gibbs company to use the double overhanging arm on all sizes. This arm provides a substantial protection to the machine, and adds to its appearance. The distinctive feature of the machine, however, lies in the system of armature winding adopted by this company. It is a modified Siemens winding for drum armatures of the four-pole type. It is wound in slots, all wire being below the surface of the armature and protected from external injury. The coils are wound entirely by machinery, and emerge from the machine in the exact shape shown in the illustration of the armature, Fig. 2. They are wound with silk ribbon, shellaced and baked. The operation of placing them on the armature is simple, as no hammering or stretching is necessary, the coils going into place naturally and without effort. It will be seen that an advance in the matter of insulation is thus assured. The body insulation consists of mica slots and heads, cemented into place and exposing the bare body in no place to the coils. As the coils are necessarily of the same length, both electrical and mechanical balance is assured,

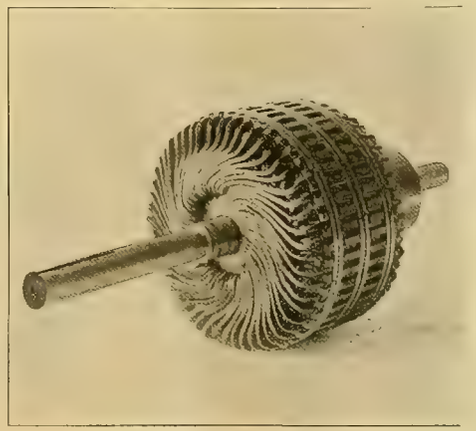


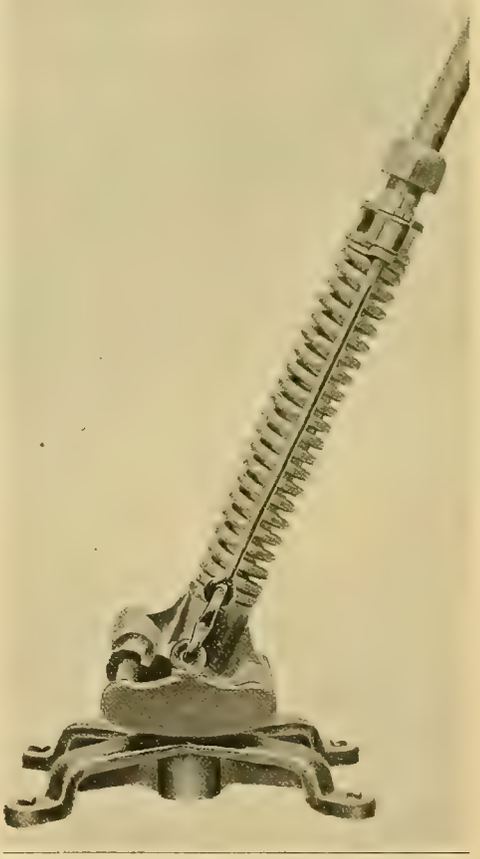
FIG. 2. A SUBSTANTIAL MULTIPOLAR DYNAMO.

A feature which would seem to be original with these machines is that the rocker arm carrying the brushholders is integral with the frame, and it is not shifted for changes in load. No sparking is apparent with violent changes in load, and therefore attendance to the machine is reduced to the replacement of the oil from time to time.

The tendency seems to be toward the automatic in all things and it would appear that this machine is an able exponent of the automatic in the electrical line. The brushholders are unique in that they are provided with only one spring for the two brushes, the pressure being equally distributed between two, and equal wear of the commutator is thus assured. The machines are built in sizes from two to 48 kilowatt capacity as dynamos and motors for standard potentials, the dynamos being compound wound and the motors shunt wound. The machine completed in Fig. 3, described in this article, is for belted power, but is similar in design to the direct connected apparatus built by the company.

The Gibbs Trolley.

Among the recent specialties to which the Metropolitan Electric company of Chicago has been calling attention is the Gibbs trolley, an illustration of which is here presented. This form of trolley is intended to meet every requirement to which such an auxiliary of street railway traffic may be subjected, and testimonials are numerous affirming the claims which the company makes for it. By reference to the illustration, it may be seen that the trolley is constructed with special attention having been paid to requirements of stability and convenience, and that in it are comprised the latest ideas in trolley construction. The Metropolitan company is prepared to furnish this device complete or in separate parts.



THE GIBBS TROLLEY.

W. R. McDonald, superintendent of the People's Electric Light & Power company of South Chicago, reports that his company now has nearly 500 arc lights in operation, and expects soon to increase the number to 600. Additional lights are now being installed in West Pullman and Roby, and the business in South Chicago is experiencing a steady growth.

The storage battery cars in use upon the Second avenue line in New York received a rather severe test during the recent heavy snow storms. On January 27th the cars ran all day and performed their schedule trips, although the horse cars on the same line were running on half time with four horses. On February 14th and 15th, the conditions were also very severe, particularly on the morning of the 15th, a foot of snow having fallen during the night On both days, it is reported, the cars had no difficulty in keeping up to their schedule. Several of the daily papers commented favorably at the time on the satisfactory performance of the storage battery cars.

AT HIGH WATER MARK

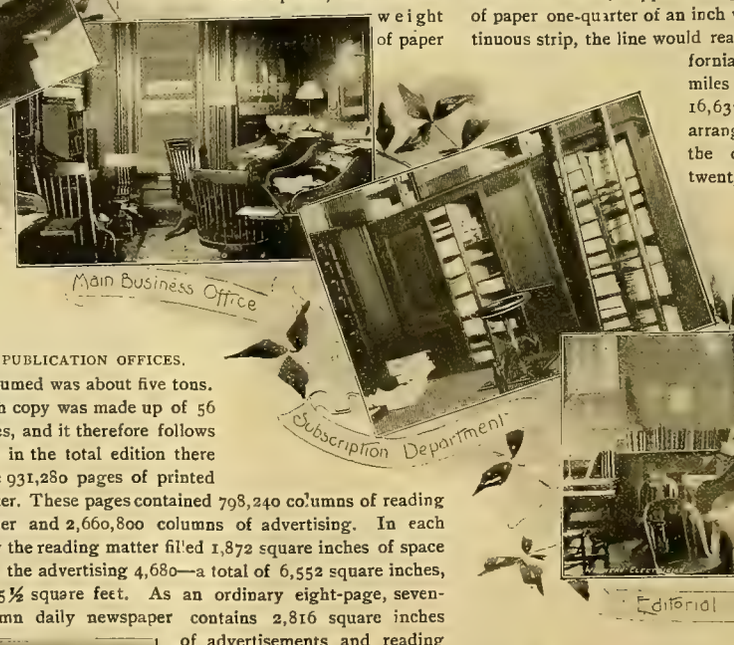
WHETHER it be in the history of an individual, a civic or business corporation, or a nation, universal experience leads one to expect that the line of progress in each case will be marked by a series of epoch-making events that will serve to distinguish the forward steps. Every person can demonstrate the truth of this axiomatic statement by a retrospective glance at his own career, and in the case of a great nation, as of the United States, the mountain peaks of history could be easily connected by a diagrammatic line with the chain of lesser events in a way to present at a glance a "curve" or graphic representation of the onward march of the American people. Indeed, every existence influenced by human thought could be plotted in like manner, and an inquiry of this sort would often lead to curious and interesting results. It is sufficient, however, for the purpose of this article to direct attention to one enterprise which, in the course of an existence that is now only approaching

"NO. 6 LAKESIDE BUILDING, CHICAGO."

the completion of the seventh year, has made a record of unbroken success, not devoid, however, of several especially noteworthy achievements, recognized as milestones of advancement. The discerning reader will have little difficulty in recognizing in this enterprise the WESTERN ELECTRICIAN itself, and it is the latest accomplishment of the series to which reference has been made that is deemed of sufficient general interest to warrant the present sketch of the rise and present status of the paper. To proceed directly, then, to the consideration of this achievement, it may be stated that in its issue of March 3d the WESTERN ELECTRICIAN reached a circulation larger than that of any other general electrical paper in the world, the edition consisting of exactly

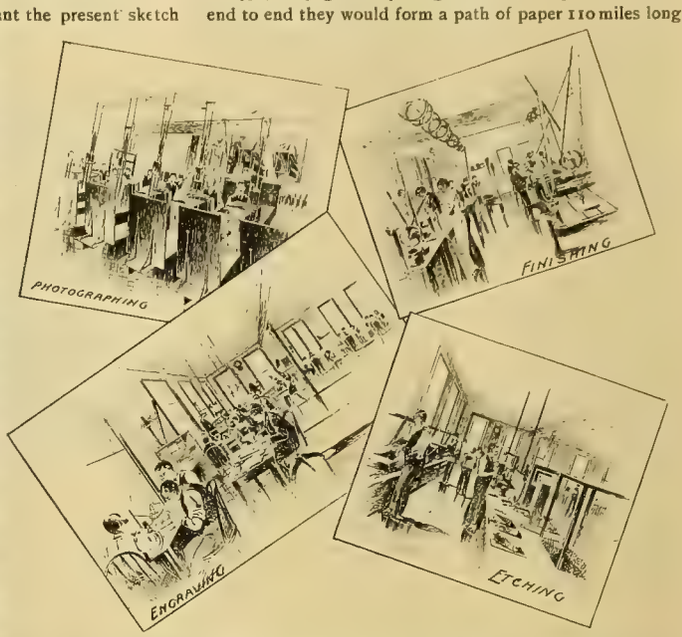
16 630 COPIES.

This issue was the one which met the delegates to the seventeenth convention of the National Electric Light association at Washington, and although so large, the papers were at hand before the convention opened—in fact, the WESTERN ELECTRICIAN was on the ground before any of the other electrical papers. The size of this great edition can better be appreciated by the consideration of a few figures in relation to it. For the 16,630 finished copies, 64 000 large sheets of paper were required, and the total weight of paper



PUBLICATION OFFICES.

consumed was about five tons. Each copy was made up of 56 pages, and it therefore follows that in the total edition there were 931,280 pages of printed matter. These pages contained 798,240 columns of reading matter and 2,660,800 columns of advertising. In each copy the reading matter filled 1,872 square inches of space and the advertising 4,680—a total of 6,552 square inches, or 45½ square feet. As an ordinary eight-page, seven-column daily newspaper contains 2,816 square inches of advertisements and reading matter, it will be seen that each copy of the WESTERN ELECTRICIAN of March 3d was equal to two and one-half ordinary newspapers; or, to place the comparison in another light, the big convention issue was equal to an edition of 41,000 copies of a large daily paper, taking no account of the great superiority in quality of paper, illustrations and presswork. Printers will be interested in the statement that the total number of columns on the 56 pages was 208, the equivalent of 500,000 ems of brevier type—the size used in setting up the body of the paper. Eight presses were required to run off the edition, which was printed from eight "forms," six of eight pages each and two of four pages each, one of the latter containing the cover pages. Were the 931,280 pages comprising the 16,630 copies to be laid end to end they would form a path of paper 110 miles long

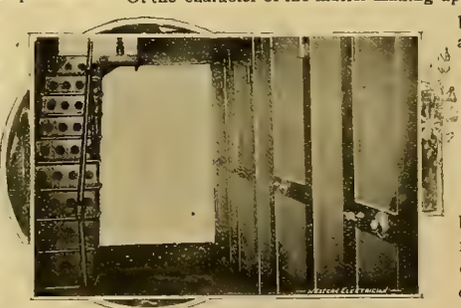


WHERE THE PICTURES ARE MADE.

and 10½ inches wide. To carry this interesting calculation still further, suppose the pages divided into ribbons of paper one-quarter of an inch wide and made into a continuous strip, the line would reach from Maine to California, with several hundred miles to spare. Again, were the 16,630 papers, each of 56 pages, arranged in the form of a circle, the circumference would be twenty-six times larger than the periphery of the Ferris wheel, or, set one on top of the other, the altitude reached

would be twenty times higher than that of the Eiffel tower. Spread out, the printed sheets would carpet an area twelve acres in extent. So it will be seen that the 16,000 56-page edition was something worth talking about. Of the character of the matter making up the body of the paper, and of the advertisements, it is unnecessary to speak; the paper has spoken for itself.

NEW YORK OFFICE.



STORAGE VAULTS.

A BACKWARD GLANCE.

The first number of the WESTERN ELECTRICIAN was issued on July 2, 1887. The paper was established by W. A. Kreidler, who, as editor and publisher, still retains a controlling interest. From the start a high standard of excellence was maintained, and the reception accorded the new venture showed that this effort was appreciated. There was no endeavor to make a cheap paper; on the contrary, it was recognized at the outset that the electrical

interests of the West were entitled to a journalistic representative at least equal in grade to the older journals of the East. This idea was ever steadfastly held in view,

COMPOSING ROOM.

and as the paper grew in strength and influence, it was determined to make the WESTERN ELECTRICIAN not only as good as any other, but a little better. The field of the

MAKING UP THE FORMS AT NIGHT.

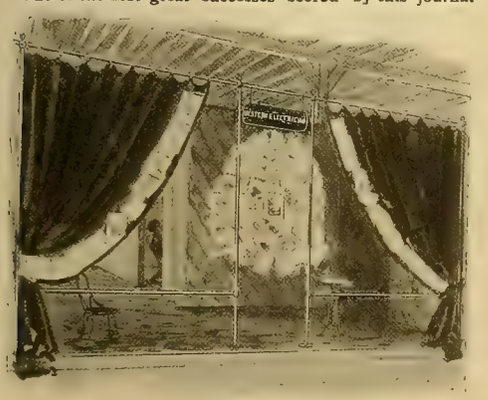
newcomer was and is pre-eminently the central and western portion of the United States, but nothing of general interest to the electrical public was neglected, and the journal long ago attained a national and international scope and reputation. On the relation of the West and the WESTERN ELECTRICIAN, the following extract from the leading editorial of the first issue will be reread with interest:

AT THE STITCHING MACHINES.

To-day the West is the great electrical market of America. Its advancement to this position has been rapid and sure. Many eastern manufacturers discovered the tendency of trade long ago, and, realizing the impossibility of handling their western business from remote distances, have either moved west or established important agencies in our larger cities. In every case the wisdom of the move has been proven.

* * * The warmth of the welcome with which the project of issuing the WESTERN ELECTRICIAN has been received is strongly evinced by the extent of our advertising columns. Our reading columns give a foretaste only of what is to be provided in that department. We believe we are well equipped for the work. With the auspices of the undertaking and the incentives before us, we hope to place the WESTERN ELECTRICIAN not only in the foremost rank of papers of its class, but in the lead. To accomplish this end no thought, labor or money will be spared.

One of the first great successes scored by this journal

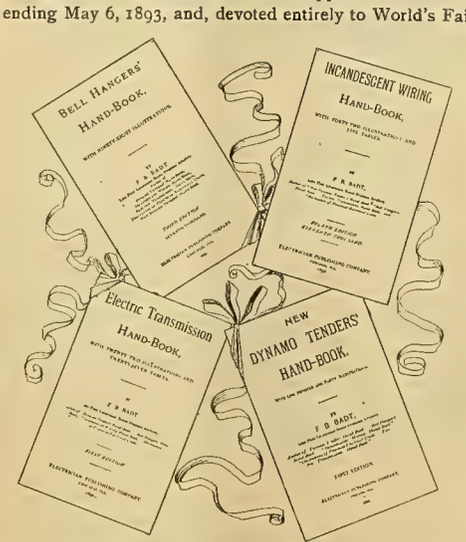


WORLD'S FAIR OFFICE.

was in the publication of the decision in the "Bate refrigerator case," which was of great importance to the electrical fraternity, owing to its bearing on the fundamental Edison incandescent lamp patents. The decision was handed down in New York almost on the eve of publication in Chicago. It was long—several thousand words—but it was nevertheless telegraphed entire to the WESTERN ELECTRICIAN, which was thus enabled, despite the disadvantage of location, to score a "beat" on all its contemporaries by exclusive publication in its regular issue. The expense was heavy, especially for a newly established journal, but it was a stroke of enterprise that attracted the attention of the whole electrical fraternity.

Another conspicuous milestone was reared on the upward pathway of the paper soon after by the feat of publishing a daily edition of the WESTERN ELECTRICIAN during the winter convention of the National Electric Light association at Chicago, in the week beginning February 17, 1889. A copy of the paper—cover and all complete—containing a stenographic report of the previous day's proceedings, with the news and gossip of the convention and editorial comment, was laid before the delegates each morning before the first session was begun. It was not a bulletin or leaflet, but a carefully edited, comprehensive daily newspaper of from 20 to 28 pages. The direct money outlay was considerable and the expenditure of nervous energy and labor far greater; but the effort was repaid by the tremendous uplift in influence given to the new Chicago electrical journal.

It was early perceived that the World's Fair would prove of the greatest importance to all branches of electrical activity, and as early as 1890 the WESTERN ELECTRICIAN recorded the first movement for electrical representation. From that time until the close of the exhibition and after the electrical interests at the fair found in this journal their warmest champion and most accurate and minute chronicler. The plans of electricity building were first made public by reproduced drawings published in this paper early in the summer of 1891. This was soon followed by the first perspective view, which was drawn in this office from the architects' plans and afterward adopted by the World's Fair authorities as an official picture. No other technical paper equaled the WESTERN ELECTRICIAN in amount of World's Fair matter or in profusion of illustrations. The distinctive World's Fair issue appeared in the week ending May 6, 1893, and, devoted entirely to World's Fair



THE HAND-BOOK SERIES.

electrical matters, was undoubtedly one of the finest and most richly illustrated numbers ever issued from the office of an American technical newspaper. The WESTERN ELECTRICIAN had its own office in electricity building, a view of which is presented in this article.

GENERAL FEATURES.

This account would not be complete without some reference, however brief, to the actual work of getting out the paper every week. The WESTERN ELECTRICIAN is generally admired for its fine illustrations and handsome typography. It is, in fact, a weekly newspaper—alert, enterprising and resourceful—produced in the elegant

IN THE PRESS ROOM.

setting of magazine work. Its readers will be interested, therefore, in the accompanying views showing the business and editorial offices, where the "copy" is prepared, the quarters of the engravers and compositors, the great

FOLDING THE SHEETS.

presses on which the paper is printed, the rooms where the sheets are folded and stitched, and finally the mailing room, from which the finished papers are sent out to the subscribers. The paper used is heavy and of exceptionally fine finish. It is made to order for the WESTERN ELECTRICIAN, the sheets being of a special size best adapted to the convenient pages of the paper.

MAILING DEPARTMENT.

Quite distinct from the newspaper, and yet allied with it in many ways, is the book department. The familiar title pages of the books constituting the famous "Handbook Series" of the Electrician Publishing company are reproduced in another column. These little volumes have proved very popular, and many thousands have been sold.

Lamp Lighting Schedule.

Following is the WESTERN ELECTRICIAN'S moonlight schedule for April:

Day of Month	Light.	Day of Month.	Extinguish.	Number of Hours.
	H. M.		H. M.	H. M.
1....	P. M. 6.50	2....	A. M. 4.40	9 50
2....	" 6.50	3....	" 4.40	9.50
3 ..	" 7.00	4....	" 4.40	9.40
4...	" 7.00	5....	" 4.40	9 40
5....	" 7 00	6....	" 4.30	9.30
6....	" 7.00	7....	" 4.30	9.30
7...	" 7 40	8...	" 4.30	8.50
8....	" 9.00	9....	" 4 30	7.30
9 ..	" 10.20	10....	" 4 30	6.10
10....	" 11.30	11....	" 4.30	5.00
12...	A. M. 12.30	12....	" 4.20	3 50
13 ..	" 1.20	13 ..	" 4.20	3.00
14....	" 1 50	14....	" 4.20	2.30
15....	" 2.20	15....	" 4.20	2.00
16....	" 2.50	16....	" 4 20	1.30
17 ..	" 3 10	17 ..	" 4 20	1.10
18 ..	No light.	18....	No light	0.00
19....	No light.	19....	No light.	0.00
20....	No light.	20...	No light.	0.00
21 ...	P. M. 7.10	21....	P. M. 10.00	2.50
22....	" 7.20	22....	" 11.00	3 40
23...	" 7.20	24....	A. M. 12.10	4.50
24 ..	" 7.20	25....	" 1.00	5.40
25...	" 7.20	26....	" 1.50	6 30
26....	" 7.20	27....	" 2 30	7 10
27 .	" 7.20	28....	" 3.00	7.40
28....	" 7.20	29...	" 3.20	8.00
29 ...	" 7 20	30....	" 3.50	8.30
30 ...	" 7 20	May 1	" 4 00	8.40
		Total.....		163.00

The foregoing schedule was calculated on the following basis:
Light one-half hour after sunset and one hour before moonset.
Extinguish one hour after moonrise and one hour before sunrise.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 26.—The rapid transit commission met last Tuesday afternoon at 22 William street and after remaining in executive session for over an hour it was announced that its report on the Busche plan had been postponed for a week. At the close of the executive session Mr. Steinway made the following statement: "At the request of one or two of the commissioners the final report has been deferred for one week, in view of the existing circumstances. Probably we shall make the report this day week."

After the meeting of the chamber of commerce upon the same day, President Charles S. Smith announced that the rapid transit act approved by the chamber is now before both houses of the Legislature and that the chamber would use its best efforts to promote its passage. However, it was for the people and the citizens at large to lend their efforts to this end. In a few days canvassers would be soliciting the signatures of business men and others approving of the bill and urging its prompt passage by the Legislature. He said that the measure commended itself to all classes of citizens and he had reason to believe that, if the citizens really desired its passage, the Legislature could not disregard their demand

The statement has been made public that the Metropolitan Traction company intends to adopt an underground trolley system upon one of its cross town lines, with a view to eventually substituting this form of motive power for horses upon most of its lines if it gives satisfaction. The company has had conferences with the Siemens & Halske, company whose system has been in operation in Budapest since 1889, and with the General Electric company, which has an experimental line of this character in Lynn, Mass. The Westinghouse company will probably be heard from soon, and it is probable that the Metropolitan Traction company will select from one of these three after their various merits have been carefully considered. What led to these negotiations was the offer of a prize of $50,000 for the invention of a motive power that should be demonstrated to be superior to the overl head trolley system, which is not allowed on Manhattan Island. Since that offer was made the company has heard from about fifteen hundred persons with more or less practical inventions to suggest, many of whom thought that they ought to receive the $50,000 check with out making a test.

The traction company will probably put the selected system in operation on one of the cross-town lines—perhaps the Twenty-third street line. The Siemens & Halske company has offered to pay the entire expense of equipping the line electrically, the traction company to furnish the cars. Probably similar offers will be made by the other electric companies. The purpose is to make it a permanent improvement, and all the cars on the line will be operated by the new system. As mentioned, if it meets the expectations of the traction company many other lines will be changed to the same motive power.

A renewal of the war over street railway franchises in Brooklyn is impending. The announcement that the Nassau Electric Street Railway company intends to begin construction of the 100 miles of surface railway for which franchises were granted by the former Board of Aldermen, promises a revival of litigation to prevent it from occupying the streets. The action of the People's Railroad company in filing a new application for permission to construct the transit lines has brought out a flood of protests and remonstrances. It may require a contest running over many months before the questions involved are finally settled.

The Nassau Electric Railroad company was organized last year with a capital stock of $6,000,000 by a syndicate at the head of which is P. H. Flynn, and in which a number of prominent Democratic politicians are interested. It was formed by the same men who had previously incorporated the Kings County Electric Railroad company. The capital stock of the latter company was not large enough to enable it to seek to secure franchises to the same streets that the Brooklyn City company had applied for. The route of the Kings County company is through Thirty-ninth street to the city line, and thence in New Utrecht and Flatbush to East New York and Canarsie. When application was made to the Aldermen for franchises for about fifty miles of city streets the Brooklyn City company applied for some of the same streets, and then the Nassau company was formed by the Flynn people. The Brooklyn City company offered $250,000 for the franchises. W. F. O.

Milwaukee, Wis.

MILWAUKEE, WIS., March 24.—A sale of $2,000,000 of Milwaukee Street Railway company bonds is being negotiated in New York. The deal is being arranged by the officers of the street railway company and by the North American company. Henry C. Payne, the vice-president of the street railway company, is now in the East. The transaction may be consummated before his return. The proceeds of the sale will be used to discharge the floating debt of the North American company and to release certain securities now held as collateral.

Several extensions of the street railway system are proposed. One of the first extensions will probably be that of the Farwell avenue line to the lake shore park. The owners of Prospect Hill, a new and fashionable residence district, are very anxious to have the line extended to the park. The line will follow the Whitefish Bay dummy road to Park place or to Folsom place and thence will go east. It is expected to have the line completed by July. The Prospect Hill people will pay about half the expense of the extension. The work of extending the Twenty-seventh street line from Lisbon avenue to North avenue is being completed. Extensions to the state fair grounds, to Cudahy, and to other points are also under consideration. Owing to the state of the money market, however, it is not likely that any very considerable extension will be built in the near future.

Vice-president Payne declares that it costs more than 4 cents to carry a passenger on the street railway system of the city and that people who travel on tickets, which are sold at the rate of 25 for $1, are carried at a dead loss to the company. The receipts of the company are below the operating expenses and the fixed charges and hence the company is disposed to go slow in the matter of establishing a general transfer system. There has been talk of establishing twenty-two transfer stations, but it will probably be some time before it is carried out. It is announced that the Wauwatosa motor line will not be changed into an electric line on account of the cost. Nor will the North Greenfield extension be built this season.

The Northwestern Electric Telephone company appears to have some intention of establishing its system in Milwaukee. The plan, it is said, is to have an exchange in each of the three principal divisions of the city, all to be connected by underground cables. If it can secure 3,000 subscribers, the company says, it will be able to furnish business telephones at $50 a year and residence telephones at $30.

The Oshkosh Electric Light & Power company will probably be sold under the hammer in a short time. William A Carey, representing the United Electric Securities company of Boston, arrived in Oshkosh a few days ago for the purpose of taking the necessary legal steps to close out the company. The company is capitalized at $21,000. Of this amount about $12,000 is held by the Oshkosh people and $9,500 by the Thomson-Houston company. The plant is bonded for the sum of $100,000. Of these bonds $65,000 is held by persons whom Mr. Carey represents and the balance by C. C. Paige, Mrs. John A. Paige, Mrs. Robert B. Paige, the Albert Sandford estate, the T. D. Grimmer estate and Bray & Choate. The Massachusetts Loan & Trust company holds a trust of the plant to secure the $100,000 of bonds and by the terms of the deed the plant can be sold at any time upon petition of the trustee. The bonds, it is said, were issued to secure money which was actually expended for enlarging the plant, and the plant is said to be twice as large as is required by a city of the size of Oshkosh. For some time the company has been engaged in a squabble with the common council over the electric lighting contract. The controversy became so bitter that the company threatened to turn off the lights and to leave the city in darkness, and the common council, on the other hand, proposed to revoke the company's franchise. A compromise was finally effected, the company accepting $68 per lamp instead of $75, which it had declared to be its ultimatum. The plant cannot be sold for more than enough to pay the bonds, perhaps not nearly as much as that, and hence the stockholders will suffer a total loss if the plant be sold. It is possible that the common council will decide to grant favorable terms to the company and that the latter will be allowed to remain in business. At any rate the company will be reorganized and placed in condition to bid on electric lighting.

An electric line is being built between LaCrosse and Onalaska. The distance is about six miles. J. R. Canterbury, the chief promotor of the enterprise, has been at work for some time, and most of the contracts have been awarded. The stock is finding a ready sale. It is proposed to run only one car on the line at first, but it will make a trip over the road every fifteen minutes.

The common council of Kenosha has granted a franchise to F. M. Kringle for a street car line. The work must be begun within sixty days and it must be finished and the line in operation within a year.

Appleton claims to be the greatest telephone town in the state north of Milwaukee. There are now in use at Appleton 120 telephones, which is 20 more than is in Oshkosh and 13 more than in Fort Howard and Green Bay together.

A committee has been appointed at Sheboygan to look into the telephone business. The step was taken as a result of a proposition made by the Northwestern Electrical company of Milwaukee, but there is a disposition to move slowly. Nearly ten months ago the Sheboygan council granted a franchise to an automatic company, but no exchange has been built and the time for doing the work will expire April 5th. It is not likely that the council will extend the franchise. C.

PERSONAL.

Walter C. McKinlock is in St. Louis making arrangements for starting the new branch of the Metropolitan Electric company there.

Thomas W. Kinsey, at one time president of the old electrical firm of Post & Co, Cincinnati, was killed by a trolley car last week. Mr. Kinsey had been living in retirement for some time.

B. J. Arnold, consulting electrical engineer, has removed his office from 565 the Rookery, Chicago, to 463 in the same building. Mr. Arnold will gain increased facilities for work by the change.

George P. Low, the widely known electrical engineer of San Francisco, has resigned his position as a member of the electrical staff of the Mid-Winter Fair, in order to give his entire attention to his increasing private practice.

George C. Baker, the inventor of the submarine torpedo boat, which has been illustrated and described in the WESTERN ELECTRICIAN, died at Washington, March 23d. The remains were taken to Des Moines, Ia., for interment.

Arthur J. Singer, formerly secretary of the Kenwood Bicycle company, has become associated with the Metropolitan Electric company in an important capacity. Mr. Singer's experience will, undoubtedly, be of considerable value to the company.

ELECTRIC LIGHTING.

Pecatonica, Ill., will soon be illuminated by electric lights.

A municipal electric light and water works system will be established at Demopolis, Ala.

It is intended to light the new government house at Rangun, Lower Burma, by electricity.

The Edison Illuminating company of Palestine, Texas, has been placed in the hands of a receiver.

The capacity of the municipal central station at Berne, Switzerland, is being enlarged by the addition of a battery of accumulators.

A company is about to be formed at Fostoria, O., for the purpose of putting in and operating an incandescent light plant with a capacity of 1,000 lights.

Prince Bismarck has made arrangements with the Hamburg house of Schuckert & Co. of Nuremberg for the electric ighting of his palace in Friedrichsruhe. The power for

the installation will be generated in a sawmill in the neighboring estate of Sachsenwalde, which is in the immediate vicinity of the palace.

The trustees of Port Richmond, S. I., are having trouble over the recently awarded contract for lighting the village, and, as a result of the disturbance, the place may be left in darkness.

The approaching exhibition at Milan is to be lighted electrically. The plant will consist of several 160 horse power Tosi engines connected to three dynamos, which will have a capacity of 400 arc lamps and 700 incandescent lamps.

The report of the special committee which has investigated the street lighting question in Springfield, Ill., was adopted at the last meeting of the city council. By its terms bids will be requested for an electric lighting plant to be owned by the city.

At a recent meeting of the Charlestown, Mass., council, an order was passed requesting the mayor to correspond with the State Board of Gas and Electric Light Commissioners with a view to securing cheaper gas for the residents of the Charlestown district.

The Dortmund-Enschede Railway company was the first in Germany to adopt electricity for lighting its carriages. Each compartment is fitted with one or two lamps fed from batteries placed under the seat. The cost amounts to 3½ pfennigs a lamp hour.

The city council of Winona, Minn., has decided to abandon the project of operating an electric lighting plant on municipal account. The committee appointed to investigate the subject reported favorably, but lack of funds prevented the council from going on with the work.

A curious proposal has recently been made with regard to the prospective electric lighting of St. Olave's in England. It has been suggested that, in the event of no land site being available for the generating plant, it should be placed on a barge moored on the River Thames.

Kalamazoo, Mich., was without light on March 13th. The city's contract with the Kalamazoo Electric company expired on March 1st. The council has failed to contract further, but proposes to erect a municipal plant if the people vote $40,000 bonds for the purpose at the spring election.

Calculations are being made for putting in an electric light plant at Lancaster, Wis. The dynamos can be driven by water power from Grant river. If the city will take sixteen arc lights and the citizens 500 incandescent lamps in their homes the plant will probably be installed.

Judging from the verdict of popular approval, the electric fountain at the Mid-winter fair has proven an unqualified success. The fountain is one of those that was used at the World's Fair, and the beauty of its constantly changing patterns seemed to have fairly dazed the Californians.

It is gratifying to note the extending influence of the electrical associations and societies. The paper read by J. H. Vail before the recent convention of the National Electric Light association was accorded over a column of editorial mention and comment in the *New York Times*. The *Times* considers the subject of electrolytic action upon gas and water pipes as one of the most important questions of the day.

Proposals will be received at the office of the superintendent of city telegraph, Chicago, until May 1st, for a system of drawing in and out electrical conduits that will provide means of distribution from the mains to street lamps and into each 25 foot lot along the street wherein conduits are to be placed. The proposals are to correspond to written requirements furnished by the superintendent of city telegraph.

The electric lighting scheme, proposals for the carrying out of which are at present being invited, for the North Sea-Baltic Canal is an elaborate one. On both banks of the canal, poles 13 feet long are to be erected at intervals of 820 feet, on which will be suspended a 25 candle-power lamp. The number of poles will be about 1,000. The locks will each be lighted by 12 arc lamps. The plant is to be in operation by April 1, 1895.

The Marion, O., Light & Power company has closed a contract with the city of Marion for furnishing 106 2,000-candle power arc lamps, on the all dark hour plan, for the the sum of $83 per year. The contract is to run four years and nine months. At the same time the company received from the city a new franchise for the term of 25 years to use streets and alleys for the purposes and requirements of the company. The company and the city are both satisfied.

The engineering firm of Johnson & Porter, which has the plans for the power house below the gorge at Niagara Falls for the Schoellkopf Canal company, is studying the various features of the work there on hand. The plans for this structure have been drawn on an elaborate scale, originally for the Buffalo & Niagara Falls Electric Light & Power company, but the idea of this company to have the new house for electric power generation this spring has apparently been abandoned. In the meantime, pending the construction of the power house below the gorge, the Schoellkopf company has utilized the big cliff mill turbine, operated under the first head of water, and has spaced off a portion of the mill, built foundations and will place big dynamos there for supplying immediate demands for power. There has been much comment on the action of the Buffalo & Niagara Falls Electric Light & Power company, it is said, in abandoning its original plans for building a power house at the Falls.

ELECTRIC RAILWAYS.

The Fremont, O., street railway is being changed from horse to electricity.

An electric railway system to connect Washington, D. C. and Manassas is contemplated.

Daniel Freeze and G. M. Parker are leaders in a scheme for an electric railway between Oberlin, O., and North Amherst.

The Camden, N. J., Horse Railroad company has commenced the work of locating the track for the new trolley road which will run along Broadway.

The St. Joseph, Mich., & Lake Shore Electric Railway company has been organized with a capital stock of $75,000 to build an electric railway in St. Joseph, Mich.

The Consolidated Electric Railway & Light company, Vancouver, B. C., has applied for incorporation to take over the franchise of the Vancouver Electric Railway & Light company.

A company is being formed at Babylon, N. Y., for the construction of a trolley road connecting Babylon with Brentwood and intervening places. The new road will probably be completed in a year.

Persons traveling to Nice, a Paris correspondent says, will shortly see the new electric locomotives which the Paris-Lyons company is building at the Oullins works near Lyons, for its fast express traffic.

The petition of the New York, Elmsford, White Plains & Mamaroneck Railroad company for a franchise to construct a railroad to be operated by electricity through White Plains, N. Y., has been granted.

It is rumored that the Jersey City, N. J., Hoboken & Rutherford Electric Railroad company will have an elevated track from the top of the Palisades to the space adjoining the Hamburg steamship line in Hoboken.

The long projected railroad up the slopes of the Jungfrau, will, it is said, at last be constructed, permission having been obtained from the Swiss Federal Council. The rack system, in connection with electricity, will be employed.

Bristol, England, is about to introduce the overhead system on one of its principal street railway lines. The necessary permission and consents have been secured for the equipment of the line between Old Meeting street and Kingwood Hill.

The power house of the Missouri Railroad company, St. Louis, Mo., was almost totally destroyed by fire March 21st. It is believed to have been struck by lightning, as it began during a severe electrical storm. The loss is estimated at $100,000.

During January a contract was closed between the French government and Mr. Berlier, a French engineer, relating to the construction and operation of electric underground railroads in Paris. It is said that about twenty-five miles of line will be built.

The latest projected electric railway of considerable length is one to connect the city of Washington with Richmond, Va. A bill has been presented to the Virginia legislature to incorporate the Southern Railway & Electric company which has this object in view. Among the incorporators are A. Pizzini, Jr., T. N. Kendler, G. D. Patch and Hill Montague, all of Richmond.

A concession has just been granted to D. Alberto Palacio, a well-known Spanish engineer, by the municipal authorities of San Sebastian, for the construction and operation of an electric street railway in that town. Although electric lighting has been very widely adopted in Spain, electric traction has made little or no progress, and it is thought that the line at San Sebastian may be the forerunner of many others.

Plans are being prepared for an elevated railroad to be operated by steam in Vienna, Austria, extending in a circle around the city, passing through the suburbs. Another semi-circular railway will be within the other, and will embrace part of the old city. This will be underground, and will be worked by electricity. In addition to this semi-circle, two other underground electric railroad lines will be constructed, crossing this semi-circle at nearly right angles. It is proposed to have both systems in operation by 1897.

The employes of the Steinway Street Railway company, whose road runs to Steinway, L. I., struck a few days ago because their wages had been reduced. The men made every effort to interfere with the operation of the line. They cut the trolley wires and tore up the track in some places; in others blockading the road with wagons, paving stones and other obstructions. Assistant Superintendent Cosgrove received a severe scalp wound from a pistol shot fired into the office of the company. The directors called upon Mayor Sanford and asked him to act as an arbitrator in the dispute between the company and its employes. He agreed to do so, and thereupon the men returned to work.

MISCELLANEOUS.

The great Schuckert searchlight projector exhibited at the World's Fair has been purchased by the government and will be mounted on the fortifications at Sandy Hook in about a month.

A syndicate is erecting a large electrolytic plant at Giemsö Kloster, which will be the first of its kind in Norway. As several of the already existing buildings and motors can be utilized, work is expected to be commenced at once.

A meeting of the Western Society of Engineers was held in the Grand Pacific Hotel, Chicago, March 7th. A paper, "Some Notes on the German Collective Exhibit of Engineering at the World's Columbian Exposition," was read by Charles J. Roney.

In a paper recently read before the Glasgow Physical society William Lackie, city electrical inspector, gave it as his opinion and experience that no ventilating system was requisite, and stated that although in Glasgow nearly 500 manholes existed, only in six of them had any trace of gas been discovered, and then only owing to damage to the gas pipes caused by the extensive railway operations being conducted throughout the city.

Suit has been brought by the Alabastine company, Grand Rapids, Mich., against the World's Columbian Exposition company for an alleged infringement of a patent which protects a special method of painting by machinery with a hose, over which the Alabastine company claim to have sole and exclusive control. Damages are placed at $100,000, and the bill also prays that the World's Fair directors be enjoined from winding up their affairs until the claims of the petitioners are settled. The suit recalls the extensive work of painting the World's Fair buildings, when this machine solved the problem which confronted the directors and effected a great saving of money and labor. In the construction period of the fair this device was brought out by one of the assistants in the decorative corps under Chief Millet.

The *Quarterly Bulletin* of the University of Minnesota dated January 30, 1894 shows the prosperity of the college. During the last year there has been added to the electrical engineering department a number of machines and instruments which will do much to render thoroughly practical the instruction of the department. Among these may be mentioned a ten-light Wood arc dynamo, a half horse power C & C constant current motor arc lamps of the Kester and Waterhouse types, six Brush transformers, a Queen portable testing set, Weston ammeters and voltmeters, etc. In addition to these a number of manufacturers have sent samples for use in the lecture room. Two large switchboards for alternating current apparatus are being constructed, one for the alternators and accessories, the other for investigating the instantaneous values of current and potential in alternating circuits.

TRADE NEWS.

The new catalogue of Hubel & Manger, 286 Graham street, Brooklyn, containing illustrations of new bells and electrical novelties has been issued and contains much that is entertaining to the electrical trade.

James B. Olson, western sales agent for the New York Insulated Wire company, has just returned to Chicago from a week's trip. He brought home a number of large orders and thinks that the outlook for an increased business during the coming months is exceedingly bright.

Lincoln & Co. have taken offices at 934-935 Monadnock building, Chicago, and intend to act as special manufacturers' agents, turning out a high class of electrical goods. It is the intention of the firm to handle carbon goods, porcelain goods, wire, incandescent lamps, etc. Mr. Lincoln has had considerable experience in this line of business and he will undoubtedly place Lincoln & Co. in the front ranks of similar concerns.

The Miamisburg Electric company, Miamisburg, O., has issued a book illustrating its Imperial dry battery that contains many hints to prospective purchasers of primary batteries. In addition to the Imperial battery the company is offering for the consideration of the trade the Burnley Cartridge battery. Both of these types are given ample space in the book. They are both open circuit batteries and possess many points of merit which commend them for the careful consideration of the trade. The book contains full directions for setting up the batteries and many handy little hints that will make it popular.

Allen R. Foote of Washington has devised a scheme for obtaining statistics showing the relative prices of electric lighting in various cities for the central station managers. Mr. Foote proposes to include in his report such facts as will explain the difference in the prices secured, including the cost of labor, power employed, etc. An association to be known as the National Statistical association, of which Mr. Foote is manager, will have charge of this work. Concerning the character of this work, Mr. Foote says: "I have recently made a study to show the deceitfulness of low prices. I selected 79 towns located in 11 states, in which all prices are $100 or less per lamp per year. I take into consideration the actual number of hours of service, and the price paid, and calculate the price for 3,000 and for 4,000 hours of service at the rate per hour actually paid. Again, I selected 19 towns located in 3 states in which all prices are over $100 per lamp per year, and calculate the price for 4,000 hours of service at the rate per hour actually paid." These returns have been tabulated, and they show that in the states paying less than $100 per year the average price for 4 000 hours is $153.27, while in states paying more than $100 the average price for 4,000 hours is only $145.87.

The business heretofore conducted by The Sioux City, Ia., Engine Works and the Pech Manufacturing company, will in the future be conducted under the name of the Sioux City Engine & Iron Works, which corporation has purchased the plant, and all assets of the Sioux City Engine Works, and also all machinery, patterns, good will, etc., of the Pech Manufacturing company. The Sioux City Engine & Iron Works commences business with a paid-up capital stock of $120,000 and a surplus of $30,000 and is composed principally of the old stockholders of the Pech Manufacturing company, the additional stock having been taken by local capitalists. The officers and directors of the new company are: President and manager, W. M. Thompson; vice-president, C. Bevan

Oldfield; Secretary, E. H. Bucknam, directors, W. P. Manley, A. F. Call, M. H. Thompson and C. A. Finkbine. W. M. Thompson, who has for the past five years been secretary and manager of the Pech Manufacturing company, and for the past year receiver for the Sioux City Engine Works, has been elected president and general manager for the new company, and is possessed of an experience which will be of the utmost value to the new company. All of the old mechanical and engineering force of the Sioux City Engine Works, whose efforts have made the Sioux City Corliss engine so popular, have been retained by the new management, and its patrons may rest assured that the high grade of work which has heretofore been turned out by the Sioux City Engine Works will be maintained in the future in the engine department; and to the patrons of the Pech Manufacturing company, it may be said that the lines of goods manufactured by them will be pushed vigorously in that department, and better satisfaction given in the future, if that is possible, than in the past.

BUSINESS.

George Cutter, Chicago, says his apparent silence is "well grounded." It may be inferred from this that the new devices on which it is said he has been working are nearly ready for the market.

A contract has been closed between Memphis, Mo., and the Franklin Electric company, Kansas City, Mo., for an incandescent electric lighting plant for that city, including a new steam plant and Edison machinery.

The Bryant Electric company, Bridgeport, Conn., is placing upon the market a new style of attachment plugs. The company manufactures three varieties, wood, porcelain covered and metal covered, the latter two being arranged for fuses. It is said that the Bryant Electric company intends to bring out some new devices shortly. They will doubtless be equal in excellence to those specialties which the company now manufactures. Thomas G. Grier, Monadnock building, Chicago, is the western representative.

B. H. Coho & Co., Mail & Express building, 203 Broadway, New York, are now contractors for the apparatus manufactured by the Mather Electric company of Manchester, Conn., for New York city, Brooklyn and vicinity, and New Jersey. Mr. Coho is well known through his connection with the Waddell-Entz company, as its sales agent, and proposes to make a strong fight for Mather business in his territory. Thomas C. Perkins, vice-president of the Mather Electric company, who is in New York city much of the time, will also make his headquarters at 203 Broadway.

The Berlin Iron Bridge company of East Berlin, Conn., is doing considerable iron bridge work at the present time. Among other contracts, it has 17 signal bridges for the Boston & Maine railroad, two bridges, 200 feet long for the town of Roxbury, Conn., a bridge 400 feet long across the Connecticut river, at Stratford, N. H., a bridge 350 feet long at Turner, Me., a bridge 200 feet long at Houlton, Me., and a bridge 200 feet long at Moosup, Conn. The iron roof for the new car barn for the Colonial Electric Street Railway company of Kingston, N. Y., will be furnished by the Berlin Iron bridge company of East Berlin, Conn.

Wells Goodhue will hereafter conduct under his own name the business formerly carried on under the firm name of Goodhue & Lincoln, Chicago. Mr. Goodhue is well known in the electrical trade and feels confident that he can offer many advantages to intending purchasers. He will continue to handle the same specialties with which he has so long been identified. The Wagner direct and alternating current power motors, Wagner fan motors and Sunbeam lamps will receive a large part of his attention. He also has a large line of second-hand Westinghouse and Slattery transformers that he has been selling a great many of, and he reports that he can furnish many more of them.

The Electric Appliance company, Chicago, is just placing upon the market something which is entirely and absolutely new. This means that it is not an improved form of something else that has been on the market, but is in itself an entirely new production—something that has never been used and probably never thought of before. It is the Allen soldering stick—a soldering flux in solid stick form to take the place of resin, acids and soldering salts. It is put up in candles one inch in diameter and six inches long, and is applied by simply rubbing on the joint when heated. It is a wonderful time-saver. It does not in any way corrode the joint or affect the insulation. The Appliance company is furnishing small sample sticks free upon application.

The National Water Tube Boiler company of New Brunswick, N. J., has just completed the erection at Youngstown, O., of a plant of 2,500 horse power of the National boilers for the Ohio Steel company. This boiler plant is considered to be a model one, covering all the improvements of modern mechanical construction, and the results will be carefully noted by iron and steel manufacturers throughout the country. The boilers are arranged in units of a little over 300 horse power each, have automatic smoke consuming furnaces, automatic carriers and feeders, and every provision for convenient handling of the fuel. The National company purchased the National boilers which were used in the World's Columbian Exposition, and these boilers are now being delivered, and will soon be erected. These, together with those just erected, will give a total capacity of over 4,000 horse power.

The Metropolitan Electric company, Chicago, has been particularly successful in the introduction of the incandescent lamp which bears its name. During the last few weeks the demand for this specialty has been steadily on the increase and the orders are of the most satisfactory character. In fact the business of this concern since the removal of its offices and sales department to 186-188 Fifth avenue, has been such as to warrant a prophecy of remarkable success. It is constantly adding new agencies, one of the latest being that for the Dayton Fan & Motor Company, Dayton, O. This company manufactures a fine grade of fan motors, ceiling fans, etc., and the Metropolitan company is making preparations for pushing the sale of this branch of its business with much vigor preparatory to the approaching warm weather. The other specialties will not suffer for this reason, however, and the trade will be made well aware of the large and varied assortment of electrical supplies which the company now has on exhibition at its new store.

Fisher & Porter, 1025 Monadnock block, Chicago, report that they see evidence of a good business in the immediate future. They are equipping with machinery a gold mine at Tellico Plains, Tenn. and have supplied Kotine, a new material for painting iron structures, for the new Lincoln Park bridge, recently erected by the Pittsburg Bridge company. They have the contract to supply two 75 horse power M. A. Green engines for the Leland hotel in Chicago, and have several contracts of a similar nature ready to be closed. They have advices from the home office of the Altoona Manufacturing company, that the works are running full time with a complete complement of men and are turning out engines as fast as the equipment will allow. One 150 horse power engine for the Farmington Light & Power company, Farmington, Ill., and one 125 horse power engine for the Western Glass company, of Colorado City, Col., are among the plants recently installed in the West. From the Providence Steam Engine company, they say "word comes that the works are running day and night with a double turn of men in the construction of the improved Green engine, of which it is the sole builder." There is evidently a demand abroad for engines, and orders are being placed where they will receive prompt atention.

Jas. I. Ayer & Co., consulting electrical and mechanical engineers, Security building, St. Louis, feel encouraged over the business accomplished in the last few months and the prospects of the immediate future. One of the important contracts which has been turned over to this firm lately is one for furnishing the design for the rebuilding of the plant of the Citizen's Electric Light & Power company, East St. Louis, which now has a capacity of 200 arc and 3,000 incandescent lamps. The firm offers its services as electrical experts and consulting engineers, for the designing of and superintending the complete construction of electric lighting plants of every character; street railway power plants and electrical construction, etc. Mr. Ayer's experience of more than ten years in designing, constructing and operating electric plants of different characters, embracing arc and incandescent plants for central stations, power plants for electric work and isolated plants for buildings, together with his thorough knowledge of the practical requirements in the operation of electrical apparatus and the management of electrical properties, particularly fits him for his present business. H. P. Broughton, the other member of the firm, graduated at Cornell University as a mechanical and electrical engineer and has been engaged in practical work in the installation and operation of electrical apparatus of all kinds used for lighting and motor power. Mr. Broughton is at present manager of the Municipal Electric Lighting & Power company, of St. Louis.

ELECTRICAL PATENTS.

Issued March 20, 1894.

516,641. Police Signal. Michael J. Burns, Lowell, Mass.

516,642. Magneto Telephone. Henry A. Chase, Boston, Mass.

516,643. Magneto Telephone. Henry A. Chase, Boston, Mass.

The diaphragm is magnetically connected to the U-shaped magnet by an iron strip, thereby increasing the receiving capacity of the telephone.

516,651. Automatic Speed Regulator for Electric Motors. William Hochhausen, Brooklyn, N. Y.

The invention consists of the combination with an electric motor, having a U-shaped field magnet, the poles of which are uppermost, of two sets of switch contact blocks or plates mounted on said field poles and connected respectively with the sections of the field magnet coils on each leg of the field magnet, and a reciprocatory switch rod or bar having spring contacts working in a groove formed by the contact ends of said switch blocks and mounted to move horizontally in a direction parallel to the armature shaft.

516,666. Electric Railway System. Elihu Thomson, Swampscott, Mass.

By suitably dividing one of the main conductors in sections at a point where it may be desired to stop the car, and by connecting the sections with suitable devices, as storage batteries graduated resistance upon the car may be dispensed with, while energy otherwise wasted in slowing down may be made available for starting.

516,677. Automatic Feed for Band Sawing Machines. Frederick E. Cross, Waterbury, Conn.

516,689. Incandescent Lamp. George C. Swan, Brockton, Mass.

516,708. Annunciator. Charles A. McCordy, Fulton, N. Y.

516,713. Electric Device for Pumping Oil Wells. Harry F. Waite, New York, N. Y.

516,731. Electric Railway Switch. Charles M. Fitch, South Norwalk, Conn.

516,771. Burglar Alarm. William Ritzman, Chicago, Ill.

516,777. Telephone Switch. Alfred Stromberg and Androv Carlson, Chicago, Ill.

The invention consists in a laterally moving switch in combination with a bracket. In placing the telephone upon its hook the switch is shifted to cut out in the local alarm, etc., and when removed a spring serves to shift the switch to cut out the alarm and cut in the receiver.

516,784. Electric Motor. Philip Wuest, Jr., Philadelphia, Pa.

516,791. Car Truck. Norman C. Bassett, Lynn, Mass.

516,792. Dynamo-electric Machine or Motor. Norman C. Bassett, Lynn, Mass.

516,794. Armature for Dynamo-electric Machines. Louis Bell, Boston, Mass.

516,796. Regulation of Multiphase Systems. Louis Bell, Boston, Mass.

516,797. Coil for Dynamo-electric Machines. Louis Bell, Boston, Mass.

516,800. Incandescent Lamp and Method of Manufacturing Same. Henry D. Burnett, Lynn, and Samuel E. Doane, Swampscott, Mass.

516,801. Guard and Shade Holder for Incandescent Lamps. George W. Demmick, Lynn, Mass.

516,804. Method of Transmission of Electricity. Jonathan P. B. Fiske, Lynn, Mass.

516,805. Transmission of Electricity. Jonathan P. B. Fiske, Lynn, Mass.

516,806. Block System for Electric Railways. John W. Gibboney, Lynn, Mass.

516,818. Electric Motor. Walter H. Knight, Lynn, Mass.

516,819. Incandescent Electric Lamp. Edward R. Knowles, Middletown, Conn.

516,820. Socket for Incandescent Electric Lamps. Edward R. Knowles, Middletown, Conn.

516,821. Electric Searchlight. Edward R. Knowles, Middletown, Conn.

516,823. Electrical Measuring Instrument. Edward R. Knowles and Lewis T. Robinson, Middletown, Conn.

516,824. Electric Signal Lantern. Edward R. Knowles, Middletown, Conn.

516,825. Electric Arc Lamp. Edward R. Knowles, Middletown, Conn., and Edwin H. Park, Milbury, Mass.

516,829. Cooling Electric Apparatus. Walter S. Moody, Lynn, Mass.

516,834. Series Parallel Controller. Edward D. Priest, Lynn, Mass.

516,835. System of Electric Distribution. Edwin W. Rice, Jr., Swampscott, Mass.

516,839. Means for Measuring Electric Currents. Lewis T. Robinson, Middletown, Conn.

516,840. Electrically Operating Pump. Cyrus Robinson, Lynn, Mass.

516,843. Electrical Hoisting Apparatus. Hollon C. Spaulding, Boston, Mass.

516,844. Lamp Socket. Alfred Swan, Schenectady, N. Y.

516,846. Regulation of Alternating Currents. Elihu Thomson, Swampscott, Mass.

Two coils, one included in the main and the other in the work circuit, are threaded upon a common core. When all of the translating devices are in circuit the coils are close, but as they are cut out of circuit they are repelled.

516,847. Means for Regulating Alternating Currents Elihu Thomson, Swampscott, Mass.

516,848. Armature Winding. Elihu Thomson, Swampscott, Mass.

516,849. Alternating Current Electric Motor. Elihu Thomson, Swampscott, Mass.

516,850. Electrical Transformer. Elihu Thomson, Swampscott, Mass.

The coils of the transformer are encased in metal or insulating material, the case then being nearly filled with an insulating fluid as oil.

516,853. Commutator Connector. Ora N. Turner, Lynn, Mass.

516,855. Electrical Measuring Instrument. Elmer G. Willyoung, Philadelphia, Pa.

516,862. Switchboard. Ellis F. Frost, Washington, D. C.

The switchboard is made up in sections or leaves hinged together, and capable of being compactly folded or of being separated to expose their faces.

516,876. Conduit for Electric Railways. Herluf A. F. Petersen, Milwaukee, Wis.

516,878. Electric Car Lighter. Joseph Sachs, New York, N. Y.

516,892. Incandescent Lamp. Rudolf Langhans, Berlin, Germany.

516,903. Railway Signaling and Switching Apparatus. John D. Taylor, Chillicothe, O.

516,987. Elevator. William M. Frisbie, New Haven, Conn.

517,000. Electrically Operated Railroad Turn Table. Howe E. Dauzenbaker, Philadelphia, Pa.

517,009. Extension Electric Chandelier. Arthur McLean, Ansonia, Conn.

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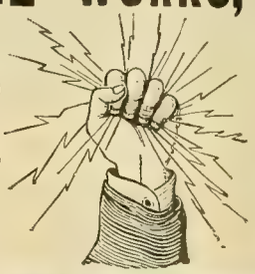

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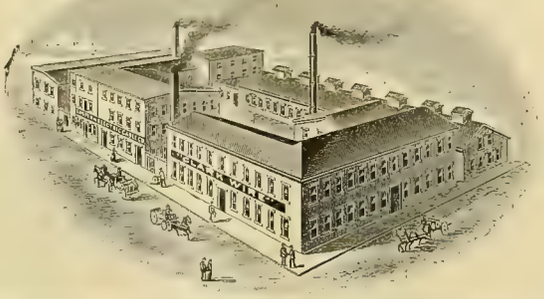

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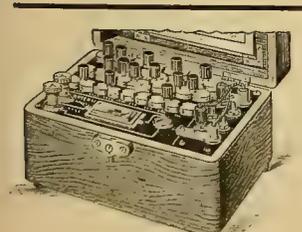

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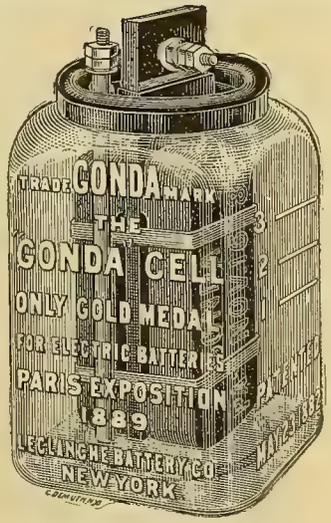

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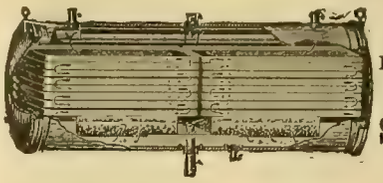

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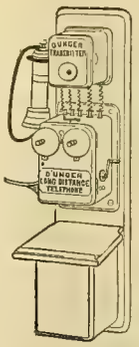

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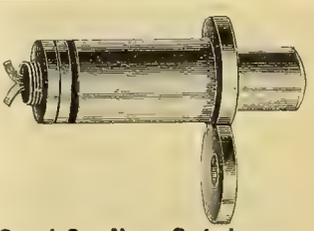

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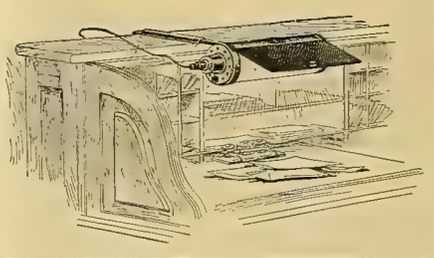

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Power Transmission Plant in the Illinois State Penitentiary.

In the early part of 1893 Warden Allen and the commissioners of the Illinois state penitentiary, located at Joliet, Ill., decided to install a central station plant, from which to distribute power, electrically, to all workshops and buildings within the penitentiary walls, to light the penitentiary from one center, and to distribute from this center steam at 125 pounds pressure to heat all of the workshops, cell houses and buildings in connection with the institution. The scheme having matured in the early part of the year, and having been worked out by the warden with suggestions from the companies consulted in the course of the investigation, the contract for the power plant was awarded to the General Electric company, August 12, 1893.

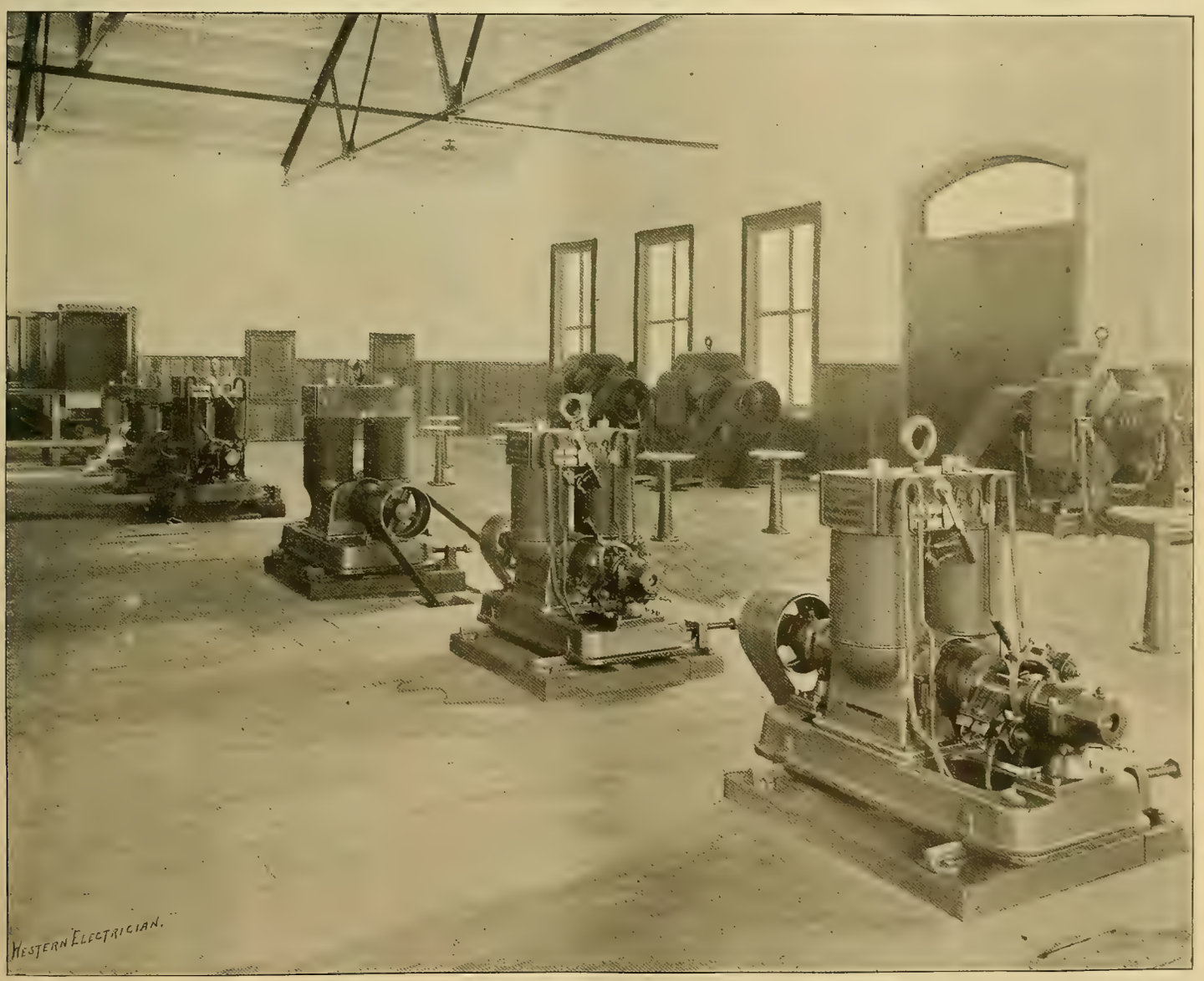

FIG. 1. POWER TRANSMISSION PLANT IN THE ILLINOIS STATE PENITENTIARY.

The plant as installed, consists of a boiler room, Fig. 2, in stone with a steel roof, containing 1,800 horse power capacity in Campbell & Zell water tube boilers, divided into six units. These boilers work at 125 pounds steam pressure, supplying steam for the heating of the whole of the penitentiary buildings by mains running underground, the pressure being reduced at the various points at which heat is to be supplied by special reducing valves which reduce the pressure from 125 to eight pounds, so that the steam in the various buildings radiates its heat under a pressure of eight pounds. These boilers also supply steam for the fire pumps, artesian well pumps, circulating pump, and all the pumps located in the pump house of the penitentiary. These boilers also furnish steam to a 400 horse power cross compound condensing Corliss engine, running at 75 revolutions per minute, of the E. P. Allis make. This engine, Fig. 3, drives a countershaft about 70 feet long, located in a specially excavated pit beneath the floor of the engine room, by means of a rope drive. The counter shaft is equipped with friction clutch pulleys, one for each of the eleven dynamos in the dynamo room a view of which is shown in the illustration upon this page, Fig. 1. These friction clutch pulleys are controlled by hand wheels, arranged in two rows. The countershaft is split between the driven sheave and the countershaft proper by means of a friction clutch coupling. The countershaft is also split in the center by a similar coupling. All these couplings are controlled from the engine room floor by specially designed hand wheels, similar in type to those used in the control of the dynamo friction clutch pulleys. The reason for splitting the shaft in the center in this way is that Warden Allen contemplates installing a second 400 horse power engine of the same type as that at present set up, to drive the same line of countershafting from the opposite end by a similar rope transmission. Thus, when the second engine is installed, one will be able to make any desired combination of dynamos and engine, thus arriving at the highest point of economy and good practice. A plan of the entire electrical plant is shown in Fig. 4.

The electric generating plant consists at the present time of three 133 horse power, 250 volt, General Electric power generators, so connected that they may be run singly or in multiple, as desired, by switches properly disposed on the handsome switchboard of black enameled slate, Fig. 5, located in the center of the room. These are compound wound generators, and maintain a constant potential for their varying loads. These generators will soon be augmented by a fourth, making a total of power generating capacity of 532 horse power, which will complete the power generating plant. These generators supply current to the motors located in the workshops of the penitentiary. The total capacity of these motors aggregate about 300 horse power, divided into twelve units, ranging from 50 horse power down. These motors operate the machinery used in the various workshops, such as the shoe shop, stoneyard, woodworking shop, chair shop, marble works, rattan shop, harness factory and run the complete machinery for the manufacture of clothes for the penitentiary from the raw material. The machine shop is also run by elec

tricity, thus distributing from one central station all the necessary power required to run all the factories and workshops located within the penitentiary walls. All of these motors are of the latest type, self-oiling bearings, manufactured by the General Electric company.

The lighting plant consists of two 25 kilowatt and four 15 kilowatt Edison type lighting dynamos, running on the three-wire system. All these machines are connected up with the single switchboard located in the center of the room. This board, as shown in Fig. 5, is divided in two by

FIG. 2. POWER TRANSMISSION PLANT IN THE ILLINOIS STATE PENITENTIARY.

an arch way, one side of the board being equipped with all necessary apparatus for the control, operation and registration of the six lighting dynamos; the other side of the board is utilized for the necessary station equipment, consisting of triple pole switches, current indicators, volt meters and automatic circuit breakers, together with the recoil rheostats with which each of the power generators is equipped. The opposite side of the switch board—that is, the side facing the engine—is used for feeder switches, cut-outs, etc., for the various lighting mains which leave the power station. All mains and feeders for the distribution of power and light to the numerous points of utilization in the penitentiary are run underground. Facing the switchboard on the opposite side to that which faces the dynamos, there is one of the direct coupled outfits of the General Electric company, used for all-night service. The roof structure of the engine and dynamo room is of steel, so that the whole power station is absolutely fire-proof and indestructible. An exterior view of the power station is presented in Fig. 6, which shows the large chimney and the substantial character of the building. No opportunity has been neglected to provide for every arrangement which would increase the efficiency and value of the installation, and when it is entirely completed it will be one of the most interesting plants of its kind in the country.

Arc Light Litigation.

In the suit brought by the Western Electric company against the Sperry Electric company for the alleged infringement of its patent upon arc lamps, No. 420,109, the

FIG. 6 POWER TRANSMISSION PLANT IN THE ILLINOIS STATE PENITENTIARY.

United States Circuit Court for the northern district of Illinois has decreed that the patent in question is good and valid, and that the complainant, the Western Electric company, is the owner of the entire right, title and interest in the patent and the invention and improvements; that the Sperry Electric company has infringed upon the exclusive rights and privileges of the Western Electric company; and that the Sperry company is perpetually enjoined from making, using or selling any electric arc lamps having an electro-magnet in the main circuit with an armature adapted to respond thereto, the strength of the magnet and the position of the armature with relation to the poles of the magnet not being changed by variations in strength of the electro-magnet in the shunt of the arc. The court further decreed that the Western Electric company recover from the Sperry company the profits which have accrued from the infringment. This is a case which has been in the courts for some time and has been closely watched with interest by arc lighting companies.

The Electrical Transmission of Intelligence[1].

By Thomas D. Lockwood.

There can be no time more fitting than the present for a review of what has been done, and an attempted forecast of what yet remains to be done, in the electrical transmission of intelligence. The jubilee of the establishment of commercial telegraphy in America is close at hand, the first Morse line having been completed between Baltimore and Washington in May, 1844.

Telegraph lines were built and operated in Germany and England by Steinheil and Cooke & Wheatstone, respectively, before the construction of the first Morse line in America. It is noteworthy that the system of Steinheil comprised a magneto-electric sending generator, a capillary ink writer and a conventional alphabet of dots, and that the Cooke & Wheatstone plan comprehended a current reversing transmitting key and a needle deflecting receiver, which indicated its messages by transient signals also formed from an arbitrary code and addressed to the eye alone.

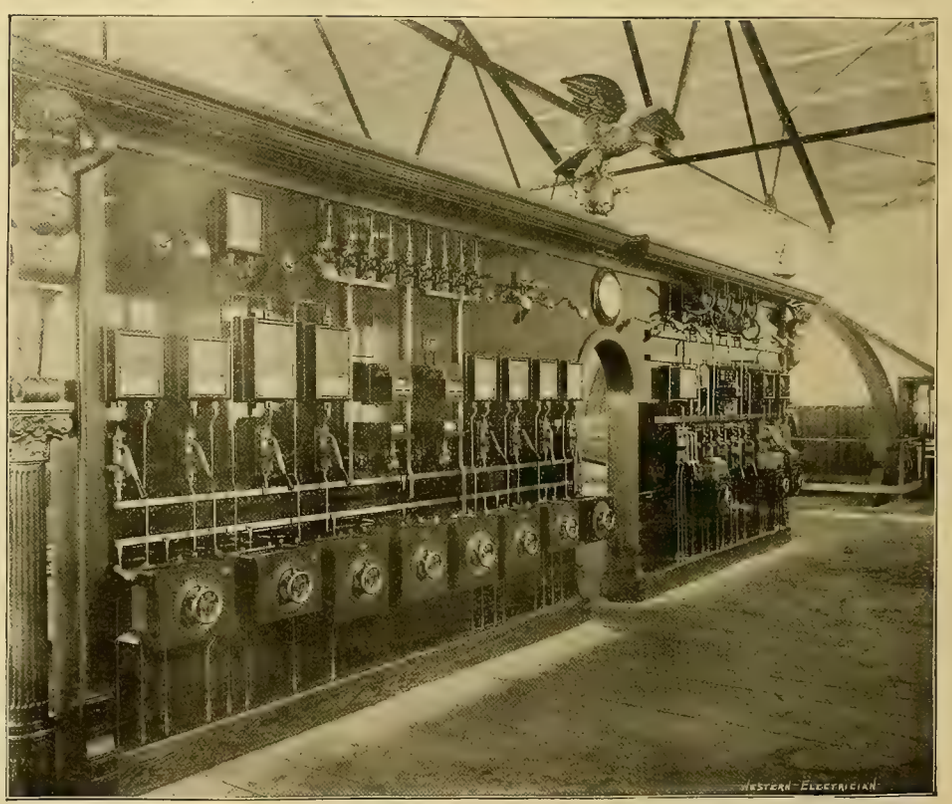

FIG. 5. POWER TRANSMISSION PLANT IN THE ILLINOIS STATE PENITENTIARY.

The Morse system consisted of an electric circuit containing a battery, a key to make and break the circuit, and a receiving register which, by means of clock work, advanced a strip of paper on which dots and dashes composing the characters of the Morse alphabet were embossed by a stylus actuated by an electro-magnet, in response to the operation of the key at the distant station.

In order that a relatively weak main line current might be used, and battery power economized, a fine wire receiving magnet called a relay, provided with a light and easily moved armature, was placed in the main circuit to respond to the key; its function being to control by the movement of its armature between suitable stops or contacts, a short circuit in which flowed the much stronger current of a local battery, which circuit also included the magnet coils of the register. By employing this device the work of the main current was made easy and consisted in merely opening and closing a light supplementary key.

The story of the telegraph in America prior to 1866, when the scattered systems of the country coalesced into what is now the Western Union Telegraph company, has no special interest for us to-day, and may be dismissed after brief notice. There had been no uniformity of practice in either construction or operation, and little material advance had been made save in the matter of physical expansion.

Though real advance prior to this time had been scant, invention had been prolific. The ingenious minds of a score of self-educated electricians had evolved as many forms of automatic repeater, by means of which, applying the principle of the relay, direct working might be effected between points too far distant to be connected by a single circuit, the sounder lever of one line serving as the sending-key of the next. Reading the Morse code by sound had become universal, except in small country offices where students and neophytes were perennial. The House and Hughes type-printing telegraphs had waxed and waned; the Phelps combination printer, an instrument embodying the best features of both of its predecessors and combining them with new ones of its own, had come into extensive use on certain lines; and in New England the automatic chemical telegraph of Bain had evanescently attempted to compete with the slower, but simpler and more trustworthy, key and sounder. Dial telegraphs, too, in which an electro-magnetically actuated pointer moved round a dial and spelled out words by halting an instant opposite the proper letters which were marked in a circle round the axis of the pointer, had to some extent been introduced in private telegraphs; and let it not be forgotten that one cable spanning the Atlantic had been successfully laid as early as 1858, and had lived and worked after a fashion for twenty-six days.

The history of the telegraph systems of foreign countries is not dissimilar. Reasons of the same character retarded their physical progression and at the same time stimulated invention, but the consummation in a majority of instances turned out to be state control instead of corporation consolidation.

Ocean telegraphy, regarded by many in 1865 as a veritable *ignisfatuus*, has long been an accomplished fact; and communication between the old and new worlds, having been finally established in 1866, has ever since been maintained practically without interruption; the speed of transmission meanwhile having raised from ten to twenty-five words per minute. This achievement was no ordinary one, and is one of which the Anglo-Saxon race on both sides of the Atlantic may justly pride itself. Besides having proved an immense convenience in the transmission of intelligence generally, the successful establishment of transatlantic cable communication has revolutionized methods of business, and has imparted a celerity and directness to diplomacy well suited to American tastes and tendencies.

Perfect insulation in land lines, once practically ignored, is now universally regarded as one of the essentials of successful telegraphy—at least in theory. We fear, however, that practice does not fully keep pace with conviction—on the western side of the ocean, at any rate.

Marked improvement has been made in insulating media and compounds, and cable manufacture, which is still practically a monopoly of the English, has reached the dignity of a fine art.

With the great influx of business everywhere attendant upon the increased popular acquaintance with the telegraph, and upon the growth of trade and commerce, came the vital question: How shall we get more work out of our wires? How best shall we work them up to their full capacity?

This has been answered in various ways. The duplex and quadruplex methods of transmission have been introduced, and have solved the problem in part by enabling a plurality of messages to be sent over one wire at the same time without interference. Multiplex telegraphs, operating by putting the same main conductors successively into contact with a number of independent terminals at both ends,

1. From the *Engineering Magazine*.

have also come into use. The main difficulty in the way of employing these was that of keeping the transferring mechanism at the two ends synchronized; but this having been accomplished by Delany, the multiplex is being successfully operated in England. Wheatstone's automatic system answers the question in another way: by transmitting communications much faster, but in single file over the same wire. In this system success has been

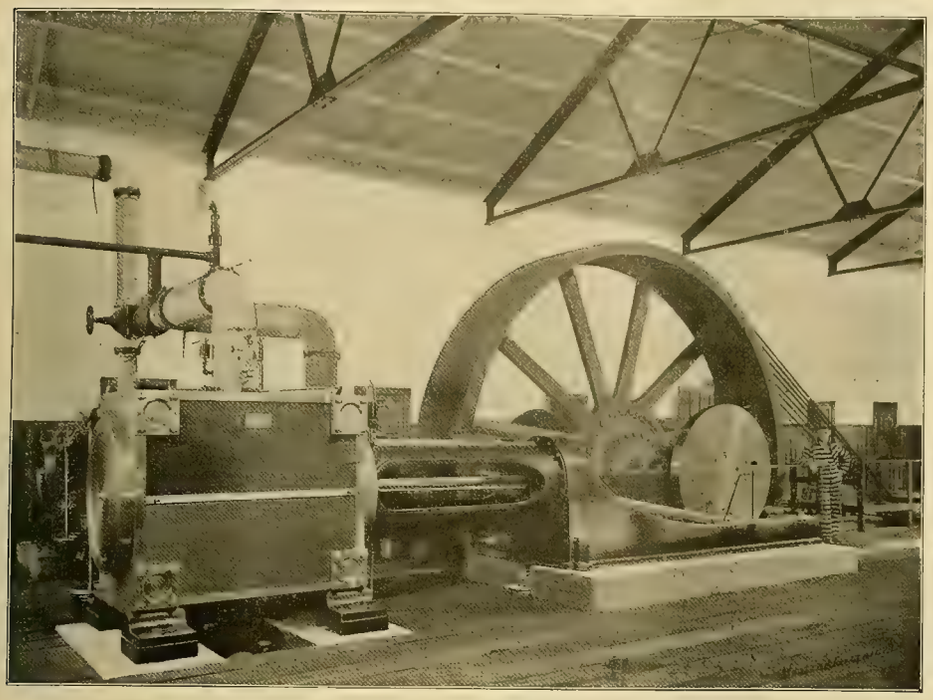

FIG. 3. POWER TRANSMISSION PLANT IN THE ILLINOIS STATE PENITENTIARY.

reached by substituting for the electro-chemical receiver of Bain and others an electro-magnetic ink writer. This automatic apparatus does excellent work in both England and America, especially in sending press matter, or where much of business is to be sent over a single wire, and under favorable conditions, and on lines which are not too long, it is capable of transmitting 600 words per minute.

Type printing telegraphs are still extant, being employed in France and on certain lines in the United States. The apparatus employed in the latter country is a highly organized machine known as the Phelps electromotor telegraph, in which the moving mechanism is actuated by an electromotor, the principle of operation being the synchronous action of the transmitttng shaft and type wheel arbor. The type-printing telegraph is likewise utilized in distributing commercial and financial information to brokers and merchants in cities; a number of receiving instruments, properly termed "tickers," being connected in serial circuit with a single central station instrument, and placed in subscribers' offices.

Entering other fields of usefulness, the telegraph gives warning of our fires, summons our messengers, and informs us of burglarious visitations; the bye-uses of the telegraph are becoming constantly more numerous and important. One of the brightest signs of the times in telegraphy may be found in the universal recognition of the advantages of systematic electrical measurement and scientific testing, both for maintenance and in the detection of faults, and in its well-nigh universal practice, which has indeed reached its apotheosis in the telegraph system of far-away **India.**

An important and valuable improvement is the employment of the dynamo for telegraphic circuits in many of our large cities. An advance equally important is the tendency toward the use of copper line wire.

We need scarcely look in the near future for radical and striking telegraphic inventions, but in view of past experience[1] we may reasonably expect a tremendous expansion in lines and business; a wider employment of the two last-named improvements; a considerable increase in city underground work; the operation of longer individual circuits; far reaching improvements in methods of collecting and delivering messages, perhaps by the increased employment of the pneumatic tube; additional speed in the operation of submarine cables; more press-matter transmission, and gradual changes in practice accruing from the introduction into the telegraphic service (which must ultimately open its ranks for their reception) of trained scientific electricians and engineers.

We hear constantly of the desirability of government ownership of telegraphs. To a candid and impartial thinker there is little in the idea which commends itself. Our party politics is still too unregenerate, and although the spoils system has sustained rude shocks, its spirit is still too rampant and aggressive to permit of a belief in the able, honest and independent governmental control and management of such an engine, when manned and officered by the party happening to be in power. Things are better as they are, especially as telegraphy is low-priced, and as what we buy is really worth what we pay for it. Let us wait at least until politics is so purified, and

1. Between 1866 and 1892 the wire mileage of the Western Union Telegraph company alone rose from 76,000 to 750,000 miles; its offices increased from 2,000 to 20,000 and the yearly number of messages transmitted rose from 5,000,000 to 62,000,000.

technical administration so stable, that a change in party control involves no greater change in governmental machinery than a change of cabinet officers and their immediate assistants; and until competency and efficiency shall be universally held to constitute, for the working forces in all departments, a full and valid title to position, permanency and preferment.

The speaking telephone belongs to the history of our own times. In March, 1876, there was not a speaking telephone in the possession of the public and not a telephone line in existence. Yet telephonic transmission in eighteen short years, has brought into use in the United States alone (in round numbers), 568,000 telephone transmitters and receivers, while the rest of the world employs about 580,000 more; and is furthermore to be credited with about 1,000,000 miles of telephone line wire, half of which, speaking broadly, is in the United States.

The telephone is like the telegraph in that the operation of both involves certain essential features; a source of electrical energy, a conductor through which this energy may travel from one point to another, and proper apparatus for delivering the message to the electrical messenger at one end of the conductor, and for enabling that messenger to tell the story at the other. But notwithstanding these similarities, telephonic and telegraphic transmissions are things distant from one another, the former standing as completely alone and without peer as did Adam, among the four-footed associates of his garden, before the advent of Eve.

The relation of the telephone to the telegraph is that which the human voice, perfect in every articulation, bears to the deaf and dumb alphabet; and for this reason alone the achievement of the electrical transmission of speech must be regarded as the veritable capstone of the present century of discovery and invention.

The transmitter of the speaking telephone may be one which actually generates its own working currents in the act of transmitting speech, as in the magneto instrument; or it may be one which, as in the variable-resistance instrument, operates upon a current already provided—say by a battery—and which, in the act of transmitting, molds the ready made current into the desired character. We may compare the action of the former to regulating the action of a steam engine by generating more or less steam in the boiler, but admitting always such amount as is produced; and that of the latter to regulation by means of a throttle-valve, the original amount generated being always the same.

But whatever form of transmitter be employed two conditions must be observed, the transmitter, in order that it may exercise a constant control over the receiver, must have a circuit which is always unbroken, and the current flowing in this circuit must copy, electrically, the changes in the air produced by the spoken words in the vicinity of the transmitter.

It is not the number of vibrations per second, but the manner in which each is performed, that gives rise to the sensation of "quality," or the articulate character of sound. To transmit the "quality" and to reproduce the "form" of sound (which includes articulations), the transmitter must control the character as well as the frequency of the motions of the receiver. It can only do this by maintaining substantially a continual control over the current by which it lays hold of the receiver; and the speaking telephone does this by using in the transmitter a device which makes the electrical changes copy those of the air in character as well as frequency, and, in the receiver, a device which makes the motion in turn a copy of the electrical changes in form and in character, as well as in frequency.

The telephone, though extremely simple in construction, has been very little changed by the years of experience which have passed since it was publicly introduced. But it has required or involved an immense amount of auxiliary invention and adaptation, and the telephone apparatus now in the hands of the user is a highly organized combination of really independent devices, capable of exercising independent functions which have been added to the telephone proper to meet as many different contingencies.

In addition to the instruments actually used in talking and hearing, it involves an alternating current generator to produce calling currents; a polarized bell to announce the call; a switch, acting by the removal and replacement of a receiver, to transfer the line between the call bell and telephones, and to open or close the transmitter circuit; a battery to furnish the initial current which is to be acted upon by the transmitter, and an induction coil associated with the transmitter, serving as an electrical lever and giving the transmitter a wide range of resistance within which it may be effective.

The generator coil is also to be ordinarily shunted out of circuit to protect it from dangerous currents or discharges, and, when located at intermediate stations, to prevent it from opposing by self-induction the voice currents which would otherwise have to traverse its coils. To

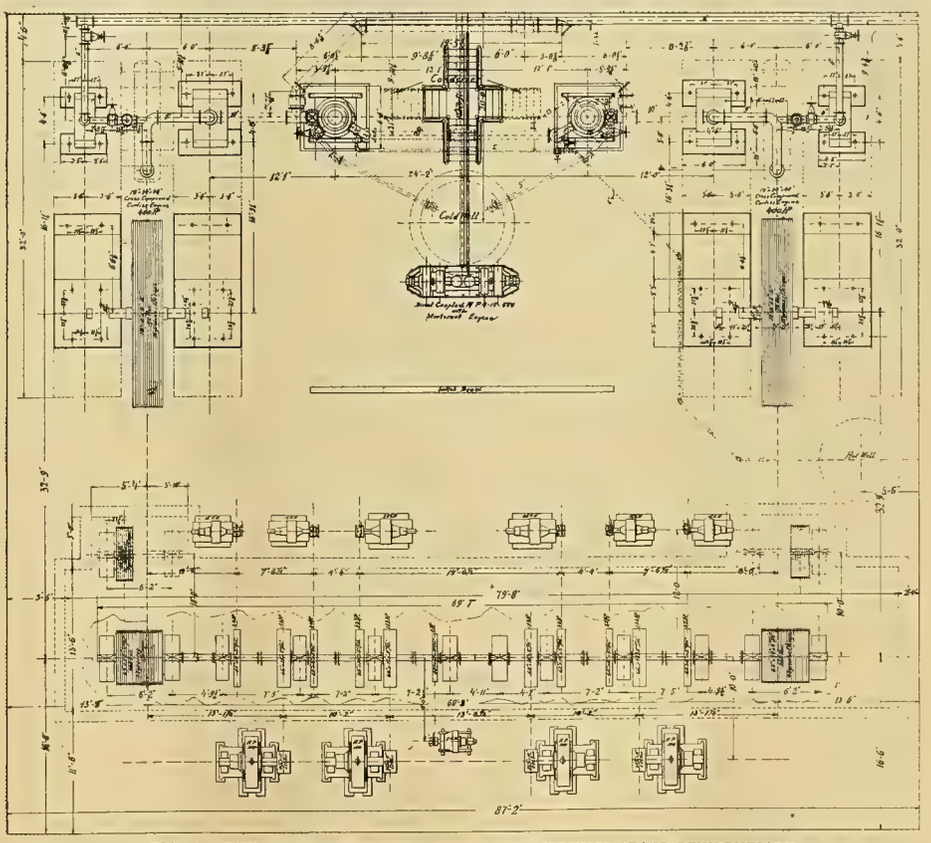

FIG. 4. POWER TRANSMISSION PLANT IN THE ILLINOIS STATE PENITENTIARY.

open this shunt circuit, a special circuit-breaker is required for convenience arranged to be operated by the act of turning the crank to send the call.

The most modern telephone lines are built of metallic or two-wire circuits, and the two conductors are placed as close together as practical conditions will permit. The reason is two-fold: the telephone current is the smallest current known which performs any useful effect, and an instrument responding to so feeble a current must be and is extremely sensitive. But, being so sensitive, it is very subject to be disturbed by stronger currents straying upon its circuit.

These stray currents sometimes come by way of the

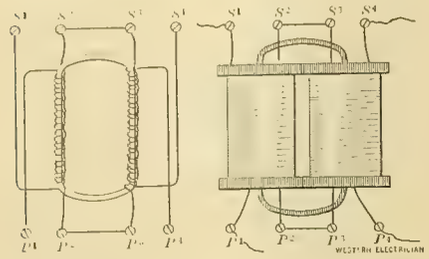

FIG. 1. THE REPEATING COIL AS USED IN TELEPHONY.

earth connections conductively, and of course cannot appear when a metallic circuit is employed; sometimes, however, they are induced within the telephone circuit by currents traversing neighboring circuits, and in that case the disturbance is quelled, not because the circuit is all of wire, but because its two wires are close together and joined at the ends, so that the disturbing currents induced in the two wires, being of equal strength and of opposite direction in the telephone circuit, neutralized each other, leaving the telephones undisturbed.

Telephonic transmission is known to the world mainly through the telephone exchange; indeed, the public seems to have reached the conclusion that the telephone and telephone exchange service are one of the same thing. It is evident that a telephone whereby I can communicate when I please with 5,000 persons, and they with me, differs immeasurably from an exactly similar instrument which allows me to talk to but one or two particular persons only, and must be infinitely more valuable. It is also evident that in paying my exchange subscription I am not paying for a telephone, but for what I can get out of my telephone; for the economy of my time which it brings about; for the ability to find out whether the man I want to see is in, before I go to see him; for the hundreds of car fares and postage stamps I am saved from using; and for the convenience of talking to scores of persons without leaving my office—no small convenience on a tempestuous day. Therefore not merely communication but inter-communication is the great field of force

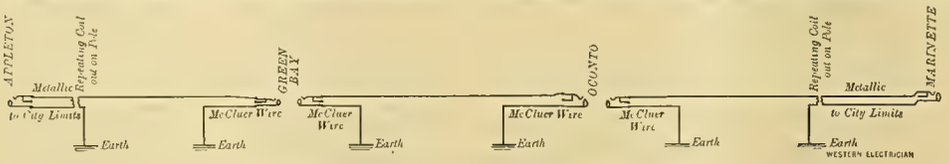

FIG. 5. THE REPEATING COIL AS USED IN TELEPHONY.

of the telephone, as is indeed manifested by the fact that nearly a thousand telephone exchanges are already in operation in the United States, and about as many more in other countries; and by the equally significant fact that 600,000,000 exchange connections were made during the year 1892—a number probably far exceeded in 1893.

The sub-station apparatus and the conductor of telephone exchange circuits need not differ from those already described; but for the great business of the exchange—that of uniting lines for through conversation at the central station to which all lines converge—other appliances are required. These are combined mainly into single a instrumentality termed the "switchboard." By it calls can be received on annunciators and sent out by special generators; lines are united, conversation coached, and disconnecting signals received.

Each exchange line is fitted with one or more protective devices to forestall damage from electric light or power currents which may come on the telephone circuits by crosses with the conductors conveying them. In the great cities of the United States the telephone exchange conductors, to a large extent, have been bunched in lead-covered cables and placed in underground conduits, there being at present some 350,000 miles of underground telephone wire in these cities.

Each cable conductor must be covered with some non-conductor throughout its length, and, as telegraphic and telephone currents inevitably travel with relative slowness and difficulty through subterranean or subaqueous cables, by reason of the retarding effects of static induction, it is highly desirable to so construct the cables that they will retain, in the manner of a Leyden jar, as little of the working currents as possible. So much success has been attained in this line of work that the cables now made have but about one-third the objectionable retarding and distorting effect that they had eight years ago.

For long line work copper wire has been found even more essential than in telegraphy, and every long distance circuit, to work efficiently, must be a two wire circuit, and its material must be copper.

The birth of commercial long distance telephony goes back no farther than 1885, but lines have already united the cities of the Atlantic seaboard as far south as Washington and have reached the western cities of Chicago and Cincinnati.

An interesting phase of telephonic transmission is that, by making certain arrangements of circuits, condensers, and electro-magnetic resistances, it becomes possible to send telegraphic and telephonic messages simultaneously over the same lines. This has been done to a limited extent with success, and the possibilities in this direction, as well as in that of multiple telephony proper, are very promising.

It must be evident from this sketch that an enormous amount of inventive thought has been devoted to the improvement of the telephone and accessory apparatus. This is further emphasized by the fact that since 1876, when the first telephone patent was granted by the United States patent office, there have been issued (up to the beginning of the present year) 805 patents of speaking telephones, and 2,235 patents relating to calls, systems, switches, special conductors, cables, and other telephonic appliances.

Such is the past of the telephone. We can but guess at its future. No doubt private lines with cheaply made telephones will increase rapidly, and that the great mass of the people will become educated in the use of the telephone. In a few years, perhaps, we hope to be as familiar with duplex telephony as we now are with duplex telegraphy. The long distance lines doubtless will continue in the future, as in the past, to exert a salutary influence over local work, raising its character and improving its facilities. It probably will be found that there is plenty of room for both

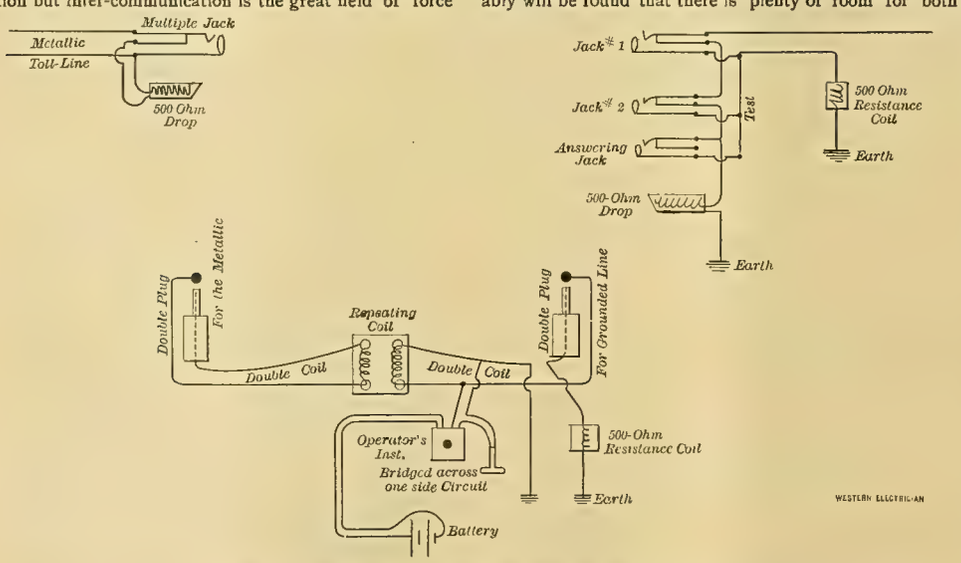

FIG. 3. THE REPEATING COIL AS USED IN TELEPHONY.

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The telephone will be extensively used in departments of work where it has, so far, merely dabbled in the shore waters, as it were, and will be increasingly employed in mining and diving operations. It will be utilized in the military and naval operations of the future, both in the transmission of conversation and as a telegraphic receiver in which latter capacity it will also be found generally acceptable. Perhaps it may find new fields of work in the permanent establishment of communication with moving trains, lighthouses, and even with vessels in mid-ocean; but so far as the last is concerned let us hope not, for that is now the only retreat from the cares of the world.

The hotel of the future will not be considered complete unless its rooms are provided with telephonic facilities for connecting them with each other, with the office, and with the outside world; factory systems arranged for the intercommunication of different departments will ere long be generally employed, and an office or a house fitted with a complete system of telephones will cease to be a rarity.

But telephonic transmission between London and New York, which some optimistic spirits are now discussing, I

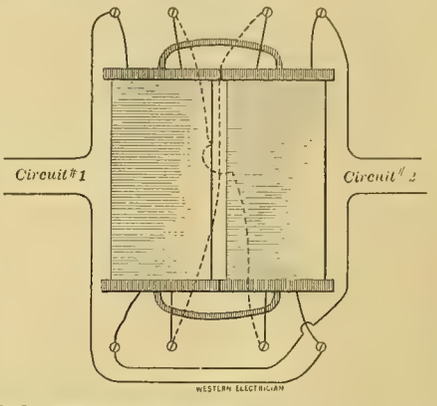


FIG. 2. THE REPEATING COIL AS USED IN TELEPHONY.

think will remain a subject for discussion only for many years to come, and need not be expected to reach fruition in time to be participated in by the writer or readers of this article on the electrical transmission of intelligence.

The Repeating Coil as Used in Telephony.[1]

By W. H. Hyde.

Since the advent of the metallic circuit toll line, the repeating coil has cut quite a figure in the operation of a

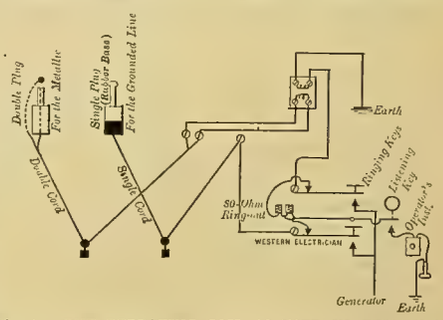


FIG. 4. THE REPEATING COIL AS USED IN TELEPHONY.

telephone exchange. It plays a very important part in making a connection between a local ground circuit subscriber and a metallic circuit toll line. For instance, should a Milwaukee subscriber who is still equipped with the old-style system, a grounded circuit and Blake transmitter, as are 1,300 of these circuits now operated in Milwaukee, or about 50 per cent. of the whole, desire to communicate with either Chicago or the East, or with any metallic toll line in the state, it would be impossible to connect the grounded line on to the metallic circuit without throwing a ground on the metallic circuit unless some device of this kind were used.

I submit herewith a diagram of a repeating coil, Fig. 1,

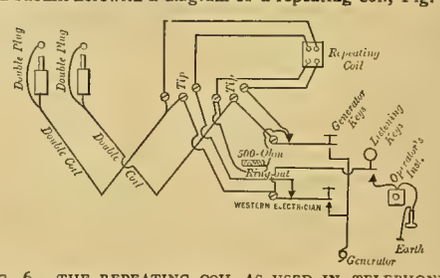


FIG. 6. THE REPEATING COIL AS USED IN TELEPHONY.

used by the Wisconsin Telephone company. The repeating coil is practically made up of two coils, as shown in the diagram, each coil consisting of a soft iron core with primary and secondary windings—the inside winding, or primary circuit of each coil being run to the four binding posts marked P^1, P^2, P^3, P^4; the inner wires of the primary circuit running to binding posts P^2, P^3, and the outer primary wires to binding posts P^1, P^4. The secondary circuits of the coils are run to the binding posts S^1, S^2, S^3, S^4, on the opposite side of the repeating coil, the inner wires taking binding posts S^2, S^3, and the outer wires S^1, S^4.

The two inner binding posts of each circuit are connected, the two outside binding posts of each circuit being the primary and secondary circuits, respectively, of the repeating coil.

The metallic circuit is generally connected on the primary, and the long grounded line, and ground, on to the secondary circuit—the secondary circuit generally being wound about 50 ohms higher than the primary circuit, to

1. Read before the Wisconsin Electric club, March 16, 1894.

increase the electromotive force, and overcome the resistance of the longer line.

When the two circuits that are to be connected are both long circuits, the connections of the binding posts may be changed so that the inside wiring of one coil is connected with the outside winding to the other coil, and vice versa, the object being to get the same uniform exposure to the fields of both coils, and the same resistance in each circuit, Fig. 2. In the repeating coil used by the Wisconsin Telephone company the resistance of the primary and secondary circuits is 110 ohms and 180 ohms, respectively.

Figs. 3 and 4 show the way the coils are connected up on the switchboards, Fig. 3 being the circuit used on mixed-circuit multiple boards, without the cam lever and ringing key circuits, which are not considered necessary to illustrate the point in view, and might be confusing; as to the uninitiated they are quite complicated.

Fig. 4 illustrates the circuit used on the smaller state exchange switchboards. By referring to Fig. 4 (both Figs. 3 and 4 being similar in operation) it will bo noticed the plug to the left is a double plug and marked "for the metallic," and the single plug, to the right, "for the grounded line." The plug to the left is inserted in the metallic circuit multiple jack, and by tracing out the circuit through one side of the repeating coil, it will be seen that the circuit is a complete metallic loop; the other plug is placed in the grounded line and the circuit is made complete through the other side of the coil by using the coil ground and the ground at the subscriber's station.

Now when the grounded-circuit subscriber talks, he talks through the repeating coil direct to ground. This is taken up by the opposite coil and transformed to the metallic circuit without material loss, thus preserving the metallic circuit intact and giving the grounded circuit subscriber the benefit of the metallic circuit talk without it being necessary for him to come to the central office for long-distance service.

The repeating coils used are supposed to have a talking efficiency of 85 to 90 per cent., and most of them do. What is lost, however, in the process of tranformation, is more than made up by the quietness of the circuit and good talk obtained.

Another use of the repeating coil is connecting grounded circuit toll lines to metallic circuit toll lines in country exchanges, the apparatus being the same as described previously.

What is called the Waukesha 1 and 2 is one of the metallic circuits running from Milwaukee to Waukesha. The line west, and extending to Madison, is a grounded line. To enable Milwaukee to converse with Madison, Waukesha makes the connection of the two circuits by use of the repeating coil, as described, and a very good conversation can be had.

In some of our state exchanges through grounded-circuit toll lines were greatly disturbed by local electric light plants, electric street railways, etc. To overcome this evil the grounded toll lines have been made metallic circuits as far as the city limits, by the use of repeating coils and return wires; the wires in the city being run pin and pin and transposed, if necessary, just as a metallic circuit would be.

By referring to Fig. 5, showing the line from Appleton to Marinette connected up in this way (the circuit from Milwaukee to Appleton being metallic), I think you can readily grasp the idea and appreciate the effect.

The coils at Appleton and Marinette are placed out on poles, in waterproof boxes (well protected by arresters to prevent burn-outs), on the outskirts of the city, or a mile or so beyond, depending on how far out the disturbing influence may run. The idea of this arrangement is to get beyond the disturbance. The lines are treated at the exchanges just as metallic circuits are.

At Green Bay and Oconto only the McCluer or return wire is used, this being a partial remedy to outside disturbances, and, as we experience very little trouble at these points at present, it does very well. As soon as they start up the electric street railway at Green Bay this spring we probably will have to place coils out on the poles at either end of the circuit and treat the north and south ends as metallic circuits, as we do at Appleton and Marinette.

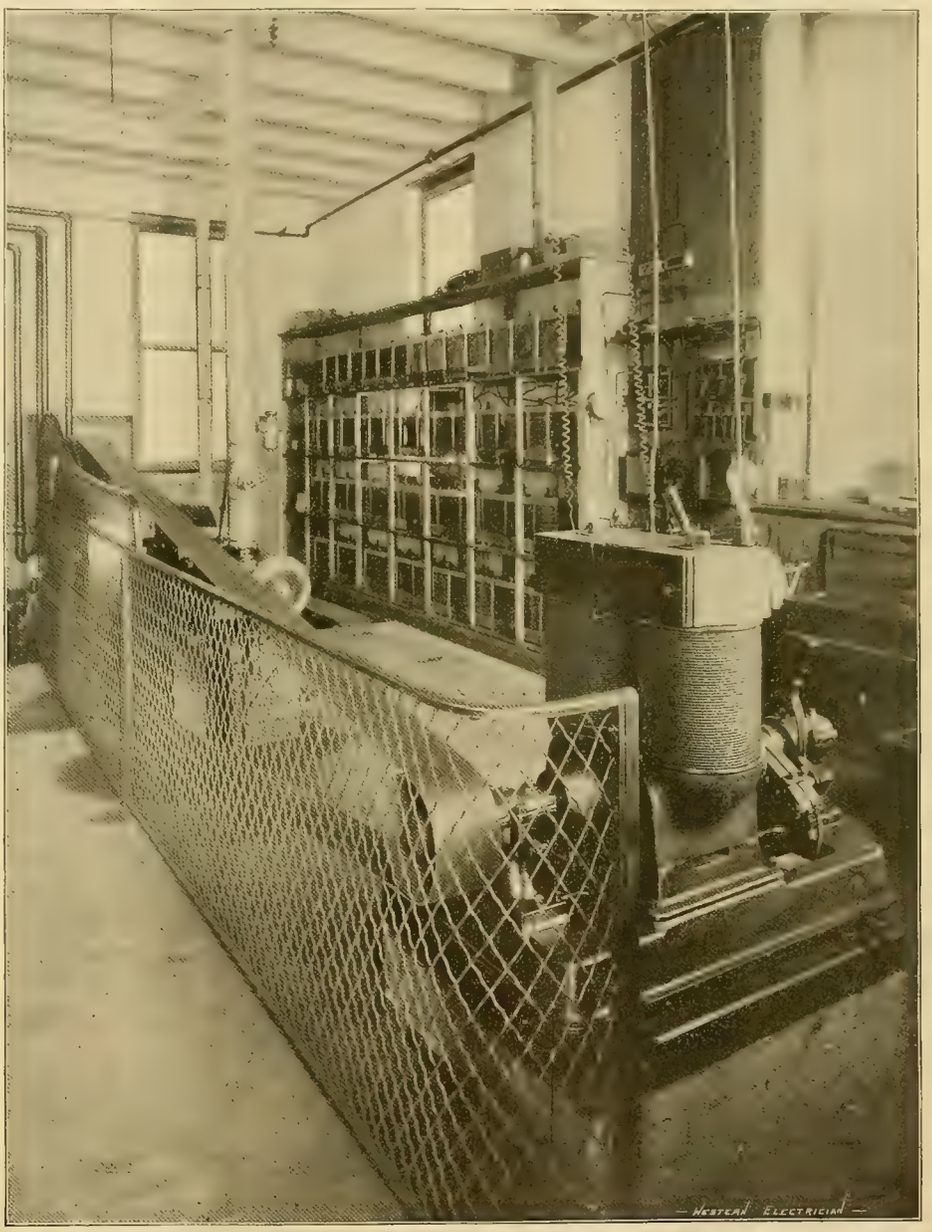
Local subscribers are connected on the toll lines at Green Bay and Oconto by the use of the repeating coil circuit, as shown in Fig. 4, and when the two ends of the toll line are connected for through conversation at these points a repeating coil with two double plugs and cords is used, as illustrated in Fig. 6.

By this method a very fair circuit is obtained with grounded lines that otherwise would be almost worthless for long talks. As there is a loss of from 10 to 15 per cent. in each coil, there is a limit to this style of conversation. On the line referred to, when connected up for through conversation between Milwaukee and Marinette, it is necessary to talk through four repeating coils, necessitating a loss of from 35 to 40 per cent., figured out according to the rate of loss per coil, and, although there is quite a depreciation in the voice at the other end, it is still clear and distinct.

Of course, the better plan would be metallic circuits for the whole distance, but until such circuits are built the present plan can be used to good advantage. Again, there are small towns that it would not pay to reach by metallic circuits, on account of the small revenue derived, and these can always be served in the way described.

Storage Battery Plant at Delavan, Wis.

The introduction of the storage battery into electric lighting plants is undoubtedly becoming more general and it is gratifying to note that it is not only in the large central station plants, where the operation of such an installation may be figured on from the standpoint of economy alone, but that attention is being paid the subject in small isolated plants, where many circumstances argue in favor of storage batteries. Such a plant may be numbered among the recent installations of the Electric Storage Battery company of Philadelphia. It is located in the Wisconsin Free School for the Deaf at Delavan, Wis., and is indicative of the many interesting applications which may be made in similar cases. This institution comprises a number of buildings isolated from the village, including workshops, gymnasium, dormitories, etc., all of which are electrically lighted. Under conditions such as exist at Delavan an electric lighting installation must be designed for supplying not only the heavy load resulting from a majority of the lights wired being thrown on in the early part of the evening, but it must provide current so that light may be obtained at any time during the night. Such an installation in an institution of this character is especially valuable from the fact that in case of fire at night, although the dynamo is shut down, the whole number of lights may be thrown upon the battery for a sufficient length of time to enable the inmates to leave the buildings by their help. The adaptability of the storage battery to such conditions is apparent. The plant is in a position to help the dynamo should it become overtaxed when full load is thrown on, and of a sufficient capacity to take care of all lights after nine o'clock, when only about one-third the number of lights are in service.



STORAGE BATTERY PLANT AT DELAVAN, WIS.

As seen by the accompanying illustration the dynamo room is neatly arranged and contains the dynamo and engine, a rack upon which are placed in position 58 type E, 11 plate, chloride cells of 250 ampere hour capacity each at 25 amperes discharge, which show a current efficiency of 90 per cent. and an average electromotive force in discharge of 2.05 volts. The solution used in this type of battery consists of sulphuric acid and water with a specific gravity of 1,275, which rises to 1,300 under full charge. The cells are placed in glass jars, resting upon insulators, in four rows. They are charged in multiple series of 29 cells each and discharged in series. The construction of this type of accumulator has been described in detail in the columns of this journal and a number of its older applications noted.

The controlling devices consists of an automatic dynamo cut-out, an automatic mercury overload switch, regulated for 27 amperes, a multiple switch for throwing the cells into two series for charging and one series, or discharging a five point compensating switch, two ammeters, two rheostats and a Quenn & Co. volt meter. The dynamo used in this installation is a five kilowatt Edison machine belt-driven by a Rice automatic, 20 horse power simple engine with a 12 inch stroke. In another room three boilers, 16 feet by 60 inches, furnish the steam supply for the buildings and a separate boiler 11 feet by 36 inches, supplies the dynamo room, where are located a number of pumps and steam engines which are utilized for laundry work, etc.

The use of this battery plant enables the engineer to run his machines at full head and hence at higher efficiency, as when the lamps do not require all the current generated, it can be shunted into the battery to be used later and of course machines running at maximum load require less coal per horse power hour than when operated at under load and they are much more efficient. The use of a battery also saves depreciation of the generating plant, for when worked in combination with a battery the machines run a fewer number of hours than would be the case were they obliged to carry the lamps all through the night. In the latter case there would also be an added expense for a night shift of engineers and perhaps a fireman.

The Geneva, Switzerland, papers announce the opening of the last section of the electric railway to the summit of the Saleve, about 5,000 feet above sea level.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CHICAGO seems determined to have rapid transit and that, too, by the adoption of the overhead trolley system for surface railway lines that do not enter the business district of the city. At the last meeting of the council ordinances were considered granting franchises on the North, West and South sides The South Side company refuses to comply with the mayor's suggestion that it light the streets upon which it proposes to operate trolley lines, but it agrees to pay $250,000 for the privilege and comply with other requirements. It is to be hoped that the city and the company will come to an understanding which will enable the people to enjoy the advantages of rapid transit in the outlying districts.

IT is gratifying to note an instance of recognition by a city council of good work done by a private corporation, and this is especially true when the company whose faithful work has called forth this acknowledgment is an electric lighting enterprise. The lamp and electric committee of the common council of Rochester, N. Y., recently made its report, and in this document is found the following paragraph.

Your committee takes this opportunity to publicly acknowledge its appreciation of the manner in which the agreement of the Rochester Gas & Electric company with the city, in reference to the building of conduits, has been carried out; all of the work done and the material used in construction being of first-class character; also, at the suggestion of your committee several important changes from the original plans, which have been deemed advisable as the work progressed, have been cheerfully made at a large additional outlay by the company.

This public acknowledgment is highly complimentary to the company and is very creditable to the committee. At the present time it is hard to find public officials who will acknowledge anything good about a corporation enjoying privileges in the form of city franchises, etc. On the contrary it is generally accepted as the popular thing to denounce all corporations on general principles whether they deserve commendation or condemnation. As a matter of fact, there are few communities enjoying such excellent service as that given by the electric companies of Rochester, and as a result the feeling between the corporations and the people is very friendly. The streets are well lighted by 1,814 arc lamps, and a net work of street railway lines operated electrically gives excellent service to all parts of the town. No doubt much of the efficiency of this service is due to the co-operation on the part of the municipal authorities and the people with the efforts of the companies. At any rate it would be well for other cities to look into this matter and emulate the example of the Flower City officials.

BUSINESS men along the lines of the "L" roads in Chicago have taken up the subject of securing a down-town terminal which will enable these roads to get into the heart of the business district and give passengers an opportunity to go from one portion of the city to another without being obliged to take a surface car between stations, or walk through the busiest streets of the town. It is proposed to extend the Lake street "L" east on Lake street to Wabash avenue, and the Alley "L" north on Wabash avenue to Lake street, making a complete connecting road between the West and South side lines. The Alley "L" trains will not stop at Lake, but at Market street, and the Lake street terminal will be at Congress street and Wabash avenue. It is also proposed that the Lake street "L" shall build a connecting loop on Halsted and Madison streets to Market street, build a branch down Halsted street to the Stock Yards, and over this route the Metropolitan "L" is to find its down-town terminal. According to those most interested in the project the right of way for the Lake street "L" has been secured on Lake street to Wabash avenue, while the Alley "L" is said to have the right of way on Wabash avenue to Lake street. The agreement between the roads and the property owners is that the extensions are to be used by both companies. In this way West siders will be able to reach the South side of the business district, and those on the South side will have an opportunity of reaching the extreme northwest part of the down-town business center. Of course, if this plan is adopted it will be necessary for the companies to substitute electric motors for the steam engines now in use. It is generally known that the South Side and Metropolitan companies have been considering this change for some time and have been securing figures from prominent electrical engineers on the cost of construction and equipment which this change would necessitate. They have come to the conclusion that the lines as at present operated cannot be made paying investments, the only hope being to get into the down-town business district and replace the steam locomotives with electric motors.

THE discussion which followed the reading of the papers before the English Institute of Civil Engineers upon the equipment and operation of the Liverpool overhead railway was not less interesting than the papers themselves. The comparison between England and this country, which seems inevitable whenever electrical advancement is considered, was made by W. H. Preece, who is especially severe in his criticism of the return to rope driving employed upon the Liverpool road. He gives us credit for better things over here. It is certainly a fact that for some time there has existed a tendency in this country toward more direct coupling for utilizing power, and it is only occasionally and under special conditions that American engineers favor such a system. Mr. Preece follows this complimentary allusion with the statement that there is nothing in this country like the Liverpool road. The statement is true. This country does not possess an elevated electric road which may be compared with the Liverpool system. While Americans are generally supposed to be in the habit of rushing into projects of this kind and experimenting considerably, it cannot be denied that very little has been done in this particular line. The best practical demonstration in this country has been the Intramural road at the World's Fair, but now that structure has passed away, and although the memory of its regular and pleasing service remains, as yet there have been no direct advantages derived from it. The road afforded ample opportunity for severe and exhaustive tests, and it was hoped that at the close of the fair a report would be made public which would do much to create confidence in the idea of elevated electric roads. Such, however, has not as yet been the case, and it is not to be wondered that although the subject has been investigated by builders of prospective roads, they have not been sufficiently encouraged to decide in favor of electricity. Just why the record of the tests made by the engineers of the Intramural road has not been made public is a matter for conjecture, but it would seem that if there is economy in the adoption of electricity as a motive power—it certainly is gained on the Liverpool road, if we may believe the figures of its engineers—no more fitting time than the present could be chosen for publication of these figures. Silence may be regarded as significant by the prospective purchasers of electrical railway apparatus, and in consequence steam locomotives may be used where electric traction would be much preferable. It is, however, probable that Chicago will be able to call attention to an elevated road, electrically operated, which will rival the representative read across the water.

AN article on "Electrical Transmission of Intelligence" by Thomas D. Lockwood, is presented elsewhere in this issue. The development of the telegraph in this country is best shown by the fact that in thirty years the mileage of wire operated by the Western Union company increased from 76,000 to 750,000; the number of offices or stations from 2,000 to 20,000 and the number of messages transmitted from 5,000,000 to 62,000,000. Regarding the desirability of governmental control of the telegraph Mr. Lockwood says: "To a candid and impartial thinker there is little in the idea which commends itself. Our party politics is still too unregenerate, and although the spoils system has sustained rude shocks, its spirit is still too rampant and aggressive to permit of a belief in the able, honest, and independent governmental control and management of such an engine, when manned and officered by the party happening to be in power. Things are better as they are, especially as telegraphy is low-priced, and as what we buy is really worth what we pay for it. Let us wait at least until politics is so purified, and technical administration so stable, that a change in party control involves no greater change in governmental machinery than a change of cabinet officers and their immediate assistants; and until competency and efficiency shall be universally held to constitute, for the working forces in all departments, a full and valid title to position, permanency, and preferment." Conservative business men generally will commend this view of the situation.

Concerning the rapid strides made in the development and utilization of the telephone, Mr. Lockwood shows that 580,000 transmitters and about 500,000 miles of telephone line wire are in use in the United States. It is a significant fact that to the great mass of people the telephone suggests merely public exchange service. The idea of private lines or the employment of the telephone in large factories for the purpose of communication between the several departments does not occur to most people who have been familiar only with the exchange feature of the business. This is due largely, if not entirely, to the policy of the Bell company which has placed such exorbitant rates upon the instruments required for telephonic communication. It is to be hoped that the expiration of the patents which enabled the Bell company to maintain its monopoly will open up this field in which there is so much promise. Mr. Lockwood incidentally refers to the project of establishing telephonic communication between this country and Europe. Evidently he has little faith in the scheme for he says: "But telephonic transmission between London and New York, which some optimistic spirits are now discussing, I think will remain a subject for discussion only for many years to come, and need not be expected to reach fruition in time to be participated in by the writer or readers of this article on the electrical transmission of intelligence." Yet there are many eminent engineers in this country and abroad who believe in the accomplishment of this project, and who are giving much thought and study to the problems which it presents.

Apparatus for Taking Alternate Current Curves.

By N. H. Genung.

Joubert is supposed to have made the first real reproduction of alternate current curves by employing a contact point rigidly attached to and revolving with the armature of the generator, and adjusted so as to make connection with a fixed brush once in each revolution. By this means he charged a condenser to the voltage of the generator at some definite and known part of the period. Some time after this curves of electromotive force, and current in both the primary and secondary of induction coils were taken by Dr. Duncan and others, the contact

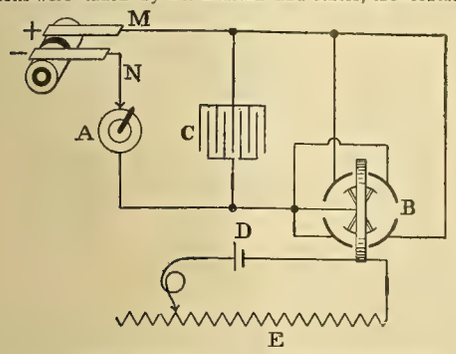


FIG. 1. APPARATUS FOR TAKING ALTERNATE CURRENT CURVES.

device already mentioned being employed. In order that the exact workings of a transformer may be known, the instantaneous values of current and electromotive force in both circuits must be simultaneously picked out and measured at definitely known positions throughout a complete cycle, and the results plotted. Prof. Ryan was the first to undertake the practical carrying out of a piece of work of this kind, and the numerous papers published by him and his associates in the year 1890, containing an enormous amount of valuable experimental data, have given us exact knowledge as to the relative phases of current and electromotive force on commercial apparatus working under various conditions, which, up to that time, had been a matter of pure guess work. Thus, both theoretically and practically, the transformer as to its working conditions was placed on a perfectly definite basis. In other words, "transformer indicator diagrams" have done for the transformer what the characteristic curves have done for the continuous

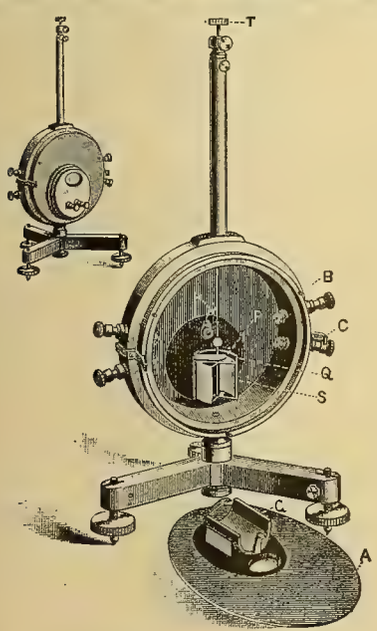


FIG. 2. APPARATUS FOR TAKING ALTERNATE CURRENT CURVES.

current machine and what the indicator card has done for the steam engine. Prof. Ryan in his work employed necessarily the contact maker and an electrometer of his own design. Many others have since employed essentially the same outfit in continuing these valuable investigations. Aside from this alternate current working has of late become so prominent a feature of electrical engineering, that in many of our leading technical schools the taking of transformer curves by the instantaneous contact method has come to form a part of the prescribed laboratory course.

The arrangement of contact maker and electrometer, as employed by Prof. Ryan and others, is essentially as shown in Fig. 1. The lines *M* and *N* come from a switch so arranged that pressures from different circuits may be conveyed to the electrometer through the contact device *A*. Values of current are obtained by measuring the fall of potential around a non-inductive resistance of known value through which the current is made to flow.

The condenser shown at *C* has usually been found necessary to obviate the effect due to leakage of the electrometer, the latter being of extremely small capacity and the circuit being closed through the contact points for but a very small fraction of each revolution. The electrometer, as designed and improved by Prof. Ryan for the purpose in view, is shown in Fig. 2. This instrument, not so perfected, was employed by Prof. Ryan in his earliest work on transformers, and has ever since been employed by him and many others almost exclusively in work of the same or of a similar nature. The quadrants are here mounted on quartz plates to insure high insulation, thus rendering the use of a condenser seldom if ever necessary. They are faced with mica to prevent short circuiting should the needle accidentally touch them. The cover plates carrying the quadrants are held accurately in position by spring clips and pins, and the opposite quadrants are connected automatically by metal strips. A small magnetic needle is rigidly attached to the system, and situated exactly at the center of the circular case, on the outside of which are wound two coils of a different number of turns, which together with the binding posts for the same, are completely insulated by means of hard rubber. The instrument may be used in one of two ways, either the electromotive force may be calculated from the deflections produced, or a zero method may be employed, the needle being returned to zero by means of a current in one or both of the coils acting on the magnetic needle at the center. The latter method is the more accurate, and is entirely free from errors due to variations in the earth's field. The voltages are with this

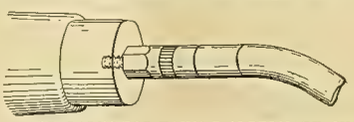


FIG. 4. APPARATUS FOR TAKING ALTERNATE CURRENT CURVES.

latter method determined in terms of the current flowing in the coils surrounding the case. The strength of current flowing may be regulated, and its values determined very conveniently and accurately by the combination of a standard cell and known resistances as shown in Fig. 1, and as employed by Prof. Ryan.

The contact maker which is to accompany the measuring device is shown in its most complete form in Fig. 3. The metal base carries a revolving ebonite cylinder driven by means of a flexible shaft, very rigid so far as torsion is concerned, easily attached to the end of the armature shaft, as shown in Fig. 4, thus making perfect alignment of the contact maker unnecessary. Brushes connect the insulated binding posts to two brass rings on the circumference of the hard rubber cylinder. The steel knife edge plug *G* attached to ring *A* may be adjusted so as to just touch at each revolution the sharpened end of a piece of piano wire forming a part of the third brush *C*, which presses continually against ring *B*. This brush, as shown, may be accurately set and clamped in any desired position with reference to the armature shaft by means of the finely divided scale at the end. This arrangement of brushes and rings avoids the use of flexible connectors, which are more or less apt to become entangled in the rotating parts. All parts necessarily handled in the course of the work are perfectly insulated so that the operator may run no risk of coming in contact with the live circuit.

A contact maker of a somewhat different design was recently worked out jointly by Profs. Ryan and Bedell, and was fully described some time since at a meeting of the American Institute of Electrical Engineers. It differs from the form herein described in that a needle point is substituted for the steel plug, as shown in Fig. 5, and a fine jet of water for the third brush, the jet being maintained by a small reservoir of water a few feet above the nozzle and connection being made by a flexible rubber tube. A binding post in metallic communication with the nozzle serves as one terminal, while connection with the needle is made through a brush resting against the revolving disk. The nozzle points slightly away from the disk, so that there is no possibility of a second contact when the projecting needle point is in the course of its revolution on the opposite side of the disk. Should the generator be a many-pole machine, more than one contact point may be inserted, so that a contact may be had with each cycle if desired. Both these forms of contact maker have been run for hours without interruption, during all of which time a fine sharp contact was to be had.

On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp.

By Prof. William A. Anthony.

Part II.

Depretz, some fifty years ago,[1] experimented upon carbon at high temperatures, first at a vacuum and then under pressure in an inert gas. In a vacuum the carbon was rapidly vaporized and deposited on the walls of the vessel, and broke before a temperature could be reached at which it showed signs of softening. Under a pressure of three atmospheres, however, in an atmosphere of nitrogen, a much higher temperature was reached, and when the carbon rod broke it sometimes bent by its own weight in the form of a letter S. He was also able to weld together sticks of carbon by means of the electric current, probably one of the earliest instances of electric welding.

It is a well-known fact that in the electric arc, carbon exists in the form of vapor. The vapor

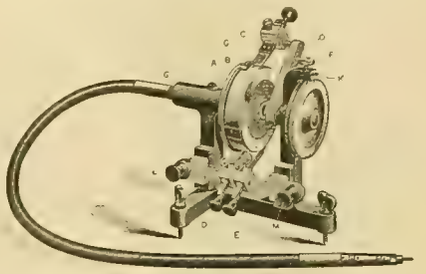


FIG. 5. APPARATUS FOR TAKING ALTERNATE CURRENT CURVES.

often condenses on the cooler negative carbon, producing a sort of mushroom growth. That it is not in the form of a finely divided solid in the arc is evident from the faint luminosity, and from the fact that the arc gives the carbon spectrum. Carbon vapor is, as shown by the spectrum, also found in the non-luminous base of a coal gas flame, but the molecules soon begin to coalesce into carbon dust which, raised to incandescence, gives the luminosity to the flame. We cannot very much increase the luminosity of a gas flame by raising its temperature by forced draft or hot blast, as the increased temperature prevents the condensation into solid dust and may destroy the luminosity altogether. Dr. Nichols[2] has pointed out that the temperature of a gas flame was not far from that of the filament of a stable incandescent lamp, and called attention to the bearing of this fact upon any attempts to improve the incandescent lamp by raising the temperature of the filament.

I think the facts and considerations I have brought to your notice show not only that there is no reason for denying the vaporation of the carbon filament but that there is every reason for believing that such vaporation takes place, and whether that vaporation is aided to any material degeee by the electrical forces or not, it is subject to the same laws as the vaporization of other substances.

What is evaporation? Modern theories of the constitution of matter assume that the molecules of all bodies are in a state of motion. In consequence of this motion some of the molecules at the free surface of some liquids and solids fly beyond the sphere of molecular attraction

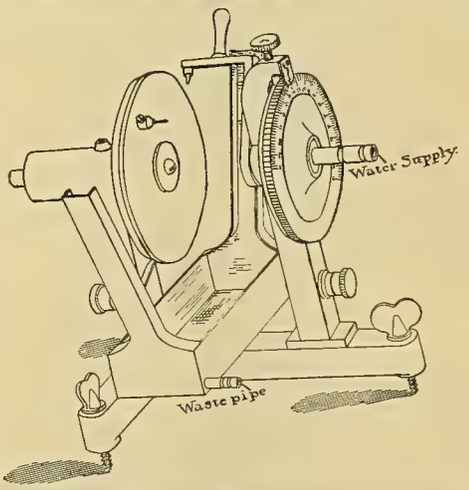


FIG. 3. APPARATUS FOR TAKING ALTERNATE CURRENT CURVES.

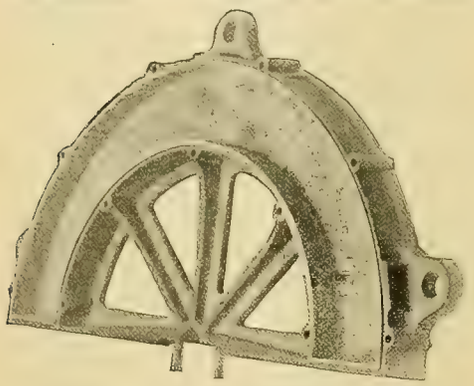
that binds them in the liquid or solid form, and when once beyond that attraction they continue on in straight lines until turned from their course by impact with other molecules or with the boundary of the space in which the body is.

These free molecules constitute the vapor of the substance. Place a lump of ice under a bell-jar perfectly void of other matter. Molecules will leave its free surface and shoot across the space in straight lines to the walls, where they will rebound and on their return may collide with other molecules, or may go back and join their fellows in the solid lump. But the number of molecules that escape will exceed those that return until, if the temperature be zero centigrade, the pressure of the vapor reaches 4.6 millimetres of mercury, at which pressure the returning mole-

1. *Comptes Rendus*, xxviii, and xxix.
2. Electric Club Pamphlets, No. 24.

cules will exactly make up for those that escape, and the ice will no longer lose. Suppose the bell-jar had contained air. It would make no difference to the fact of vaporization. If the ice is at such a temperature that the molecules escape at all, they will still escape when the air is present, but many of them will at once collide with air molecules and be turned back, and the result will be that there will soon be so many vapor molecules in the layer next the ice, that the returning molecules will nearly equal the escaping molecules, and evaporation will take place very slowly; but all the while some molecules of the ice vapor will find their way among the air molecules to greater and greater distances, and the perfect balance between the outgoing and returning molecules will not take place until, at the same temperature, the number of free molecules is the same as before. Suppose in the first instance, when we had the vacuum to start with, the bell-jar was kept at a temperature of say 5°, while the ice remained at 0°, some vapor molecules would coalesce to form frost on the inner surface of the bell-jar, and since the pressure of aqueous vapor at—5° is only 3.1, while at 0° it is 4.6 mm. of mercury, there will be a constant flow of vapor toward the walls until the lump of ice is all gone. If under the same conditions as to temperature, the bell-jar contains air, precisely the same thing will take place, except much more slowly. If the air in the bell jar be at—5°, the vapor molecules in their collisions with the air molecules will lose some of their motion, some of them will coalesce to form frost crystals in the air, and we might have a cloud of even a fall of snow. If our lump of ice were made the negative electrode of an induction coil the agitation of its molecules would no doubt be increased, more of its surface molecules might be driven off, and with greater velocity, they might go in straight lines to much greater distances before being deflected, but it would in no way alter the general result. The presence of air would retard both the deposit of frost on the walls and the waste of the lump of ice.

The bearing of all this upon the action going on in the incandescent lamp is obvious. At the high temperature of the carbon filament, carbon molecules do sometimes get beyond the reach of molecular attraction. These molecules will, when once they leave the filament,



MICANITE INSULATION FOR RHEOSTAT BOXES.

if there is nothing in their path, go straight to the walls of the chamber. Because of the lower temperature of the walls, the molecules will lose something of their motion by the impact, and, after successive collisions, will have lost so much that they will coalesce and form a coating of solid carbon on the walls.

The condition here is precisely the same as that of the ice in vacuo. The free molecules of carbon constitute a true carbon vapor. Nothing that we know of carbon warrants us in denying this, and all we do know favors the conclusion. The maximum tension of the vapor is extremely low, equivalent to saying the velocity of the molecules is small, hence the presence of a gas of low pressure is sufficient to check the motion and cause the molecules to quickly accumulate at the maximum density near the carbon filament, when the molecules will return to it as rapidly as they escape.

But in the lamp a new condition is met with, one that would be hardly appreciable in the bell-jar in our ice experiment. In consequence of the great difference of temperature between the filament and the walls, convection currents will be set up in any gas contained in the chamber. The layer of saturated vapor near the filament will be carried away by these currents of gas, leaving room for the formation of more vapor and further waste of the filament. But there is a great difference in gases as to the formation of convection currents and it is, therefore, not a matter of indifference what gas is used in the lamp chamber. It should be a gas in which convection currents are a minimum.

Gases of great molecular weight, like bromine and iodine, possess the desired qualities, and when used in proper quantity in the lamp chamber not only prevent the blackening but retard in some degree the waste of the filament. If we could in any way, by mechanical means or otherwise, still further check the circulation of the gas within the lamp chamber, we should still further check the waste of the filament and prolong the life of the lamp.

I call your attention again to the results of the experiments with bromine lamps. Under all conditions of running at normal or abnormal temperatures they blacken less than high vacuum lamps, they also increase less in resistance, and, therefore, for both reasons their candle power is better maintained. I have shown that this is just what we should expect from all known laws of the formation and condensation of vapors. I have, perhaps, spent more time than was needful upon the question of the electrical agency in the formation and carrying of the vapor, but there seemed to be such an air of mystery surrounding the "Crookes' tube effect," or "electric carrying," or passage in "straight lines," that I thought it worth while to try and clear that up, so far, at any rate, as it relates to incandescent lamps. It all comes to this, that electrical vaporization—vaporization mainly produced by the direct action of electrical forces—is only observed in connection with great differences of potential, sufficient to give sparks several centimeters long in air. The rectilinear motion is only a consequence of the freedom from interference. In the incandescent lamp the potential differences are small, the temperature is higher than that of a gas flame where carbon vapor does exist. Why, then, should it not exist in the lamp as a result of the high temperature alone? Recognizing its formation there, and considering all the various conditions that exist in the lamp chamber, it is seen at once that the light and mobile gases might, although they prevent the blackening of the walls of the

HARD RUBBER TELEPHONE RECEIVERS.

chamber, increase the waste and shorten the life of the filament, and we are led at once to the selection of a heavy and viscous gas. With such a gas in the lamp, and a properly proportioned filament, the initial efficiency may be carried as high as in the vacuum lamps and the efficiency and illuminating power will be well preserved to the end. Since the resistance of the filament does not increase, it has not the advantage of working at a lower and lower temperature as is so often the case with the vacuum lamps, the strains due to sudden changes of temperature in extinguishing and relighting the lamps are greater because of the higher temperature, and it is to be expected that the rupture of the filament will occur earlier in its life. But experience goes to show, that the bromine lamp will outlast the efficient life of the vacuum lamp and give a more satisfactory, because a more uniform, service.

Micanite Insulation for Rheostat Boxes.

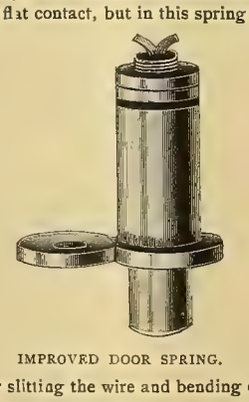
In the accompanying cut is shown a new specialty which the Mica Insulator company has placed upon the market. It consists of a micanite lining for rheostats, and, as shown in the cut, it is in position in the rheostat box. This is a new departure in the business of this company and many advantages are apparent to be gained by the use of micanite for this purpose. The Mica Insulator company is the sole manufacturer of micanite plates, commutator segments, rings, washers, tubes, troughs, taper rings, cloth paint, etc., for electrical insulation.

Hard Rubber Telephone Receivers.

In the accompanying cut is illustrated a sample of the work being turned out by the Columbia Rubber Works company, Chicago. R. T. Whelpley, the manager of this concern, announces that it has all the necessary dies and tools for making the hard rubber parts of telephone receivers and is ready to furnish them in any quantity. The company carries a large stock and can fill orders promptly. Its extensive facilities for producing hard rubber specialties enable it to make receivers or fittings of any style. A drawing or model is all that is required for preparing samples.

Improved Door Spring.

Heretofore springs of the kind illustrated have been very ineffective owing to the imperfect connection made by a straight pin or flat contact, but in this spring this difficulty



IMPROVED DOOR SPRING.

is overcome by slitting the wire and bending out the ends, as shown in the accompanying cut, thereby making a taper, rubbing and positive contact.

Owing to its small size, this spring can also be used on inside blinds, etc. It is made by Huebel & Manger, manufacturers of electrical goods, Brooklyn. The work and material is of excellent quality, and the spring will undoubtedly prove popular.

A Visit to the Works of the Ball & Wood Company.

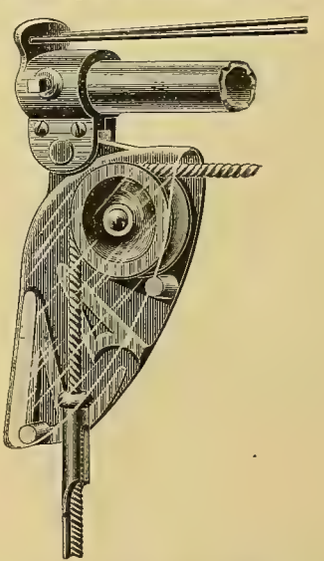
The Ball & Wood company of New York extended an invitation to a large party of its friends to be present at the works at Elizabethport, N. J., March 31st, to inspect its new vertical engine of 600 horse power capacity, previous to its shipment to the Chicago Edison company. A large number were in attendance, including many leading engineers who pronounced the working of the engine first-class, it bringing out several new features in engine building.

As the visitors arrived at Elizabethport they were welcomed by President Thomas C. Wood, Vice-president Frank H. Ball and Secretary Chas. R. Vincent, who explained in detail the construction of the engine and escorted them through the extensive works, which are equipped with all modern tools and apparatus for handling heavy castings including a Shaw electric crane. After the inspection of the engine and factory, an invitation was extended for those present to partake of an elaborate lunch in which the continued success of the Ball & Wood company was toasted by all. Secretary Vincent, although suffering from a broken arm, was not prevented from being present.

A large party of ladies added very much to the occasion by their presence and none were more interested in listening to the discussions of the various engineering experts.

Cutter's Mastarm Pulley.

The lamp supporting pulley brought out several years ago by George Cutter has proved so successful for use wherever arc lamps are hung from suspension wires, that there has been quite a demand for a mastarm form of this style of pulley. To meet this call, Mr. Cutter has designed the pulley shown in the accompanying cut, which has already been given extended trial at a number of



CUTTER'S MASTARM PULLEY.

places with most gratifying results. This form is built on the same general lines as the one for center suspensions, but has a special clamp which will fit the iron pipe as commonly used on mastarms. The clamp also serves as a cap for the pipe arm, so that the bracing can be done from this extreme point, just as has been the custom with the Cutter, Thomson-Houston and other first class mast-arms. All the parts are well made, and neatly japanned, the snap-hook knob being of malleable iron. This knob is automatically guided into its seat when the lamp is raised, and just as readily released, there being no springs, pawls or catches to be clogged by snow or sleet. The lamp supporting feature acts as a perfect safety device, and as the action is automatic the whole arrangement combines the good points of a pivoted mastarm with the simple and rigid design of a fixed form. The new pulley is made by George Cutter of Chicago.

Electrical Heating Apparatus.

On March 26th the following specifications for the installation of electrical heating apparatus were adopted by the city electrical inspection department of Chicago:

(*A*) All arrangements for making connections to heating devices must be fixed and permanent, and the current shall not be carried beyond the permanent fixture. The apparatus must be so designed that whenever the device containing the "resistance" is removed the circuit shall be automatically broken.

(*B*) No flexible cord or wire or movable wire to be used. The wire to the permanent fixture shall be strictly in accordance with the rules for safe wiring of the same voltage.

(*C*) The permanent fixture shall be placed in a safe situation, and isolated from inflammable materials; shall be on non-combustible supports, and at least four (4) inches from floor, or other woodwork in its vicinity, en

tirely composed of non-combustible material, not concealed but in plain sight.

(*D*) The "resistance" itself shall be enclosed in a fireproof case.

(*E*) Each device, or set of contacts, shall be protected by a proper fusible cut-out under the regulations laid down in rules for safe wiring.

(*F*) There shall be a double pole self-acting switch for each circuit which shall absolutely and plainly indicate to the eye whether the current be "on" or "off."

Paragon Speed Indicator.

One of the articles which is being pushed by the Metropolitan Electric company, Chicago, is the Paragon speed indicator. This device is shown in Fig. 1, where a portion of the bearing in which the spindle revolves is cut

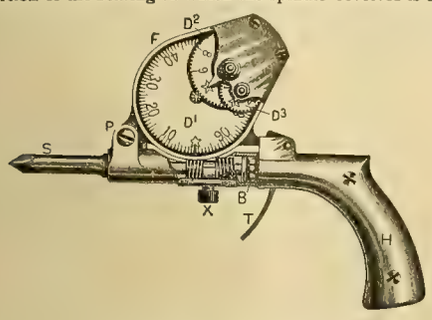
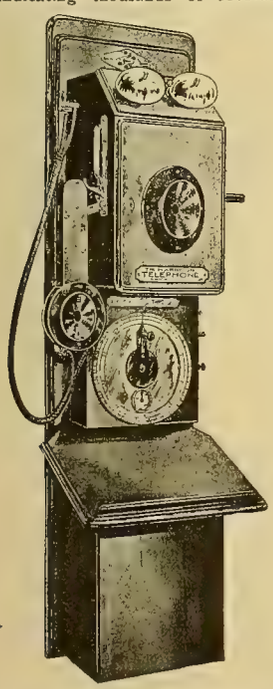


FIG. 1. PARAGON SPEED INDICATOR.

away so as to show the worm gear connections, and also to illustrate the ball bearing at the inner end of the spindle, designed to sustain the end thrust when the device is in use. *H* is the handle, *S* the spindle, which has its outer end angularly pointed and its inner end provided with a ball bearing, *B*. *F* is the frame in which the dial wheels D^1, D^2, D^3 are mounted and this frame is pivoted to the stock at *P* so that it can be moved downward on such pivoted connection against the force of a spring, to cause the teeth of the dial-wheel to engage with one of the worm gears on the spindle *S*. The letter *D* designates the dial-wheel which meshes into the worm gear, and is graduated to indicate units and tens of revolutions. This dial-wheel has a pinion which meshes with a dial-wheel D^2 indicating hundreds, which in turn actuates another dial-wheel D^3 indicating thousands of revolutions.. This



HARRISON INTERNATIONAL TELEPHONE.

"thousands" dial is found very useful in connection with such high-speed machinery as dynamos, motors, etc.

The dials can be easily and quickly reset to their normal positions at zero by turning the thumb-nut (which will be found at the back of the dial frame *F*) until the star on each dial-wheel is opposite its respective pointer. The letter *X* designates the shifter slide, which carries with it the two worms, one right-hand and the other left-hand, which, though mounted to rotate with the spindle *S*, have a sliding movement thereon controlled by the shifter *X*. This shifter may be pulled to the right or left according to the direction in which the shaft is running, as indicated by the letters *R*, *L* on the slide, thereby revolving the dial-wheels always in the same direction, thus avoiding confusion in reading the result by having only one set of figures.

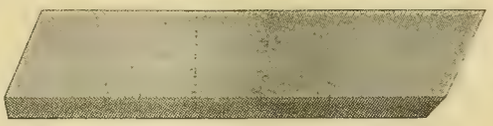
The letter *T* indicates the trigger form lever, by pulling which the dial-wheels are brought into operation, and which, in combination with the pistol-grip handle *H*, gives the instrument its accuracy.

The method of using the device is shown in Fig. 2. The merits of this indicator are so pronounced that it will doubtless add materially to the stock of ready selling specialities which the Metropolitan handles.

Harrison International Telephone.

The Harrison International Telephone company, organized under the law of the state of Illinois with a capital stock of $80,000,000 is exploiting the telephone which is illustrated in the accompanying cut. The directors of the company are Stephen B. Elkins, New York; R. C. Kerens, St. Louis, Mo.; George R. Peck, Chicago, Ill.; Thomas J, Hurley, Fort Worth, Tex; C. M. Ferree, Kansas City, Mo.; Robert P. Porter, New York; William Warner, Kansas City, Mo.; L. E. Ingalls, Chicago, Ill; H. M. Holden, Kansas City, Mo.; A. L. Stone, Chicago, Ill. and E. M. Harrison, Fort Smith, Ark.

The Harrison international telephone is not a magnetic telephone and is not affected by the weather or temperature. The patents for its exchange system, magnetic bells, lightning arresters, switchboards "both automatic and manual," generators and all other devices are the sole property of this company, and consequently free from royalty or tax of any kind which go to make the cost to subscriber excessive. The devices are of the simplest kind, which lessens the possibility of its getting out of order. Prominent patent attorneys have stated as their opinion that the



A PERFECTED DYNAMO BRUSH.

company's patents are original and sound, and in no way infringe on any existing patents. The transmission of vocal sound is clear and distinct, whether long or short. distance.

Great perfection in telephone service is attained in the automatic telephone switch, controlled exclusively by the Harrison International Telephone company. By the use of this switch ninety per cent. of the expense of the central station is saved, as it does away with the operator or call girl. All communications over the wire are strictly confidential, as no one but the two conversing can get access to the wire. The device by which the connection is made is so simple that a child can operate it, as there are no keys to manipulate. The certainty of securing the right connection is absolute, and the annoyance of being cut off or run in on is all done away with. There is a dial on the face of the telephone, as seen in the cut, not unlike that of a clock. By touching a certain attachment the automatic indicator is turned to the number on the dial wanted, when a button must be pressed. This is the complete operation. If the instrument called is busy, there is an indicator on the dial of the instrument which informs the subscriber of the fact.

These instruments are leased to corporations or individuals and not sold outright. A contract is given the company or individual leasing the telephone in which the Harrison International Telephone company agrees to defend all suits brought for alleged infringement of patent, also agrees to keep in repair all teelphones leased from it and to replace, without cost to lessee, telephones lost by fire or the elements. The Chicago office of the company is located in the Chamber of Commerce building.

A Perfected Dynamo Brush.

The General Electric company has perfected its woven wire dynamo brushes, a cut of one of which is presented, and has now ready a complete line of them for all the machines it manufactures, Edison bipolar, Thomson-Houston bipolar or multipolar, and in fact all with the exception, of course, of the arc dynamo. The brushes are made of fine wire gauze, which is first wound into rolls and then shaped into brush form under heavy pressure. They are smooth, give excellent contact, run cool and do not fray.

Feeder Panels for Electric Railway Switchboards.

The disastrous results usually incident to short circuits in power stations are too well known to street railway managers and have been too vividly impressed upon them to need extended description. A precautionary device, which could always be relied upon to give complete and independent control of each section into which the system is divided has for years been a real necessity in every complete station equipment. This section control is needed to avoid the disablement of the entire system by trouble on any one section which may arise from a variety of causes. Furthermore, a proper system of feeder distribution and section control serves another useful purpose, for if a short circuit on one section should cut off all the current, a severe mechanical strain is placed upon the station machinery, and still another strain occurs if the load on all sections is thrown on simultaneously. A suitable division of the system into sections, each of which is controlled at the station, is therefore incumbent on every electric railway.

In order to provide for this convenient and necessary

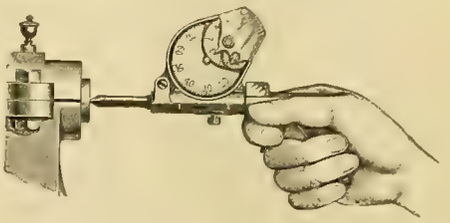
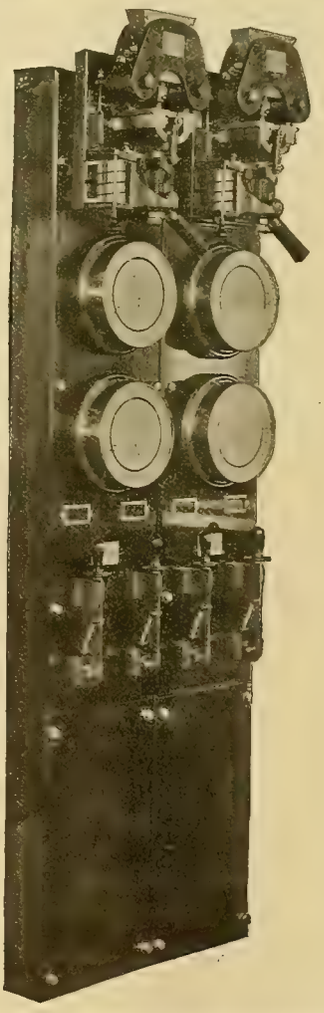


FIG. 2. PARAGON SPEED INDICATOR.

control, the General Electric company has still further perfected its railway feeder panels which are made for different numbers of feeder circuits; that known as form "C" adapted for two circuits, being shown in the accompanying illustration. It is fitted with a circuit breaker, two ammeters, and two single pole switches. The automatic circuit breaker is known as form "K", and is of the latest and most improved design. It will interrupt repeated short circuits without damage to itself, and can be instantly reset. The magnetizing coils will carry 1,200



FEEDER PANELS FOR ELECTRIC RAILWAY SWITCHBOARDS.

amperes continuously and can be adjusted to 1,800 amperes for temporary overloads. The fuses are of excellent design and can be cheaply and quickly replaced. They are of copper and are coiled to secure some electric magnetic effect and diminish the flashing when melting from overload. The terminals are made with a view to avoid the damage from any ordinary short circuit.

These panels are designed to be bolted side by side with the generator panels, and are supported by vertical angle irons, which can readily be bolted to the angle irons

furnished with the generator panels. The line bus bar is of the same height so that the feeder panels can be connected in circuit by simply extending the line bus bar of the generator panels. Some of the forms of these panels are equipped with circuit breakers and some with fuses. The circuit breaker acts more quickly in opening the circuit and can be more quickly closed. The fuse acts more slowly, but when blown cannot be replaced as quickly as the circuit breaker can be closed. Feeder panels thus made will prove valuable acquisitions to every station switchboard. They are now being made in large numbers to meet a rapidly increasing demand.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 2.—The state board of railroad commissioners has approved the application of the Brooklyn, Queens County & Suburban company for permission to change its motive power from horses to the electric trolley system on that portion of its road on Metropolitan avenue beginning at the Brooklyn City avenue and ending at St. John's Cemetery in Newtown. The board has also approved of the change of motor power to the electric trolley system in many portions of road operated by the Brooklyn, Queens County & Suburban Railroad company.

Seven copies of the petition sent out by the Chamber of Commerce in favor of the new rapid transit bill were returned to Secretary George Wilson March 28th, filled with signatures. They contained about 5,000 names. There remain in circulation thirty-three copies, which will probably be turned in soon. While this activity proceeds, the rapid transit commissioners have taken two adjournments without doing any business. Mayor Gilroy is bitterly opposed to the Chamber of Commerce rapid transit plan. When asked for his opinion of it he said he did not care to go into a general dicsussion of it at this time, but he was opposed to it and had always been opposed to any scheme that would compel the city to lend its credit. "This is a monstrous proposition," he said. "The very basis of it is that the city must lend its credit, and that, as it would not pay private capital to go into it, the city should go into it. If it is such a brilliant speculation, the men who are behind the scheme could command the capital to build the road without any aid from the city. The fact is, an underground railroad in this city will not pay." It is feared that Mayor Gilroy will not receive hearty support in this expression of opinion. New Yorkers have waited so long for a decided move in the direction of rapid transit that they will not sympathize with a policy so antagonistic to the present agitation. Rapid transit is being discussed more vigorously than ever and an underground road electrically operated is the popular solution. The mayor's statements do not carry weight and seem to have been uttered almost thoughtlessly.

Electrical inspectors made a raid on private wires last week. Under orders of the president of the board of electric control, twenty-five men were started out one morning. They had orders to cut every overhead wire, except those authorized by the board. By noon more than five miles of wire down town had been removed. Among the companies whose wires were cut were the Western Union and Postal Telegraph companies, the Manhattan Railroad company, E. P. Holmes & Co., the New York fire department, the Brush Electric Illuminating company and the Metropolitan Telephone & Telegraph company. Every wire along Frankfort, Water, Front and Wall streets, and Maiden Lane for which a permit could not be shown was cut by the inspectors. Many wires were cut without even the formality of notifying the owners. In speaking of the work of the inspectors, Col. Theodore Moss, the secretary of the board of electrical control, said: "Every private overhead wire in this city, except those licensed by this board, will be cut down. Hundreds of offenders against this law have been notified to remove their wires, without avail. We are on the watch for private wire stringers, and those caught putting any up without a permit, as it seems is done daily, will be arrested and locked up. From the Battery to Twenty-fourth street, along Broadway, there is not a single overhead wire. Such shall be the case clear to Harlem within two weeks, or we will stop doing business."

The plant of the United Electric Light & Power company, at the foot of East Twenty-ninth street, was seriously damaged by fire last week, and the lighting of the district extending from Fourteenth to Fifty-ninth street, and from river to river, was interfered with slightly. The fire, which started in the morning, resulted from the burning away of the insulation of the wires at the main switchboard. The station of the company is a two-story brick building, extending for 100 feet along the south side of Twenty-ninth street, near the river front, and is 75 feet deep. The switchboard was on the second floor of the building. The flames were confined to second floor and roof of the structure, but the dynamos and other apparatus on the ground floor were badly damaged by water. The loss, about $15,000, is covered by insurance. Manager Brown said that, fortunately, the company was provided with an overlapping system, by means of which all the lights in the affected district would be supplied from the Harlem station and the down-town station. W. F. O.

New Engand News.

BOSTON, March 31.—The contest between the electric and steam railroads is to be one of the most interesting and hard-fought battles at the present session of the Legislature. It has been brewing for many weeks and broke out in the House with full force March 13th, over the bill to authorize the Worcester & Millbury Street Railway company to extend its tracks and increase its capital stock or issue bonds. The contest upon this bill came upon an amendment offered by Mr. Russell of Boston to the effect that the street railway should not cross the tracks of any steam railway at grade. After an hour's debate the amendment was killed, and the bill was ordered to a third reading by a *viva voce* vote by an overwhelming majority. It was a victory for the electric roads.

The continued hearing upon the subway question was opened March 15th by Chairman Dalton of the commission, submitting written and printed testimony as to what is being done in New York in the way of forwarding the interests of a subway in that city. A bill similar to that now before the transit committee has been introduced in the New York legislature, and a provision made for the expenditure of $30,000,000 in furtherance of such a rapid transit scheme. In answer to the chairman, Mr. Dalton said he was only prepared to endorse a $5,000,000 issuance of bonds for a subway in Boston. The importance of the enterprise being undertaken by the people of Boston seems to be thoroughly appreciated and an earnest effort is being made to secure the best means of rapid transit. Boston stands in nearly as much need of better transportation facilities as New York, and practically the same plan of an underground electric railway which is the favorite in New York seems to be met with the most general approval here. Several plans are under consideration, however, and all will be given careful consideration.

The Legislature has been petitioned by a number of influential men for a charter to construct an elevated electric road in Boston and some of its suburbs. The route over which it is proposed to operate the road is quite extensive, and would be an important factor in relieving the crowded districts of the city—a problem, the solution of which, is causing so much discussion. The system adopted is that of R. T. White of Medford, Mass. It is the intention to construct a double-track belt line, covering a total distance of about three and one half miles, around the congested district of Boston proper, without traversing either Washington or Tremont streets, and to have the various suburban lines come into the city and make a circle upon this belt line, thus leaving passengers from any suburb within at least five minutes' walk of any part of the principal business district.

As stated, the motive power used in connection with this system will be electricity. It has not been decided as yet whether it will be advisable to use a trolley wire between the tracks or to adopt the third rail system as exemplified at the World's Fair.

The system invented by Mr. White is specially adapted to the narrow streets and sharp curves of this city. The track will be constructed entirely of steel—there being no wood or wooden ties whatever, and for this reason, there will be little or no objection raised on account of obstructing light, as is the case in New York, where the wooden ties form almost a complete flooring overhead. In connection with the road a new safety switch will be used for which many advantages are claimed.

At a recent meeting of the council the committee on the fire department recommended that the committee on finance provide $15,000 for the employment of electrical experts in the several fire districts. The board of fire commissioners says that the men connected with the wire department end of the fire alarm branch of the fire department must respond to the alarm for all large fires. Their duty is to look after the wires that interfere with the firemen. The better way would be to have men for this service who are familiar with electricity. The commissioners are strongly in favor of a corps of electricians connected with the fire service. The council referred the report to the committee on finance.

S. P. D.

Northwestern Notations.

MINNEAPOLIS, March 31.—The Northwestern Telephone Exchange company has made a proposal to put in a new automatic system at Little Falls, Minn.

Allen Curtis, trustee for the bondholders of the Stillwater Street Railway company, has secured a verdict against the company for $67,709.20. The road is to be sold soon.

The General Electric company of Boston has assumed control of the electric light plant at Austin, Minn., and has placed G. W. Haskell in charge.

H. C. Kendall, who organized the Duluth Telephone company in 1880, has sold his interest in the enterprise, it is said, to the Bell people of Chicago. The capital stock is $100,000, and Mr. Kendall is reported to have realized $32,000 for his stock. This would give the Bell company a controlling interest.

M. B. Ridgway, a Minneapolis man, has mapped out a project for a new line of railroad to Duluth, to be operated by electricity, with power stations along the proposed route at intervals of 12 to 15 miles.

The officials of the Twin City Rapid Transit company report a gradual increase in the daily receipts. They say that the falling off during the recent period of depression was not so great here as in most western cities.

The street railway company here is experimenting with new illuminated signs to designate cars and will probably put them on all cars.

The Minneapolis council has let the contract to Tobin & Gleason to put underground the city's police and fire alarm wires. Their bid was $6,585.46. The Standard cable will be used.

Judge Seagrave Smith, of the Hennepin County District Court, has decided against the street railway company, the case in which the enforcement of the Harvey ordinance was sought. The ordinance requires the giving of transfers at any intersecting point as well as at the central transfer station. He holds that a franchise is not a contract, but a license. The case will be appealed.

A fire in one of the large Minneapolis clothing stores is reported to have been started by an electric flatiron. This has led to an order by the city wire inspector that each heater must be connected with a wall switch and an incandescent lamp placed between it and the switch. Each lamp and switch must be furnished with individual cut-outs of the Edison make, and each heater placed on a wire mat with ¼ inch air space.

The Owatonna, Minn., city council has voted to put in an electric light plant, incandescent and arc, for city and commercial lighting, at a cost of $15,000. The Owatonna Electric company has a five-year franchise now, and, it is said, will make a fight.

The Great Falls, Mont., Fuel company has put in electrical machinery for sawing fire and kindling wood, and will probably put in a splitter. The plant cuts 30 cords an hour.

The Duluth city council, after several months' deliberation, has voted down, by a vote of 7 to 6, the ordinance giving A. A. Harris and others a street car franchise.

At Northfield, Minn., improved electric service for street lighting is contemplated.

Nothing has been done toward letting the contract for electric lights for which bonds were voted by the city of Glencoe, Minn.

At Fergus Falls, Minn., Major Curry is meeting with success in his efforts to secure an automatic telephone system.

The La Crosse, Wis., Street Railway company is experimenting with galvanized iron vestibules.

Citizens at Henderson, Minn., hope to have electric lights and telephone connection with the Twin Cities. Hermann Brothers propose to run an electric plant in connection with their planing mill.

An ordinance was introduced in St. Paul giving the East Side Electric company permission to string or put wires underground in all parts of the city. It has a permit now for certain sections.

The city officials of Winona, Minn., have been visiting other cities to get points on the lighting question.

N. L. P.

PERSONAL.

George A. McKinlock, president of the Central Electric company, has gone to Old Point Comfort, Va., for a couple of weeks' rest and recreation.

Announcement is made of the marriage of James H. Rhothamel of St. Louis to Miss Nancy Rex at Chicago, on March 27th. Mr. and Mrs. Rhothamel will make St. Louis their home.

Those who were startled and pained by the announcement last week of the serious accident to John L. Martin, Chicago, which resulted in the loss of an arm, will be surprised to hear of his speedy recovery. Although an amputation was found to be necessary, Mr. Martin is

gaining more rapidly than might be expected. He was standing on a railroad station platform, and as a train was in the act of starting he slipped and fell under the wheels, which crushed his left arm. The many expressions of sympathy for Mr. Martin which were heard were a testimonial of the esteem in whichhe was held by his friends in the electrical fraternity.

George P. Low of San Francisco has been appointed consulting engineer for the Board of New City Hall Commissioners of that city. The San Francisco city hall is an imposing structure and Mr. Low has been engaged as designing and supervising engineer for the installation of its electric lighting plant. It is stated that the probable capacity of the proposed plant will be 6,000 incandescent lamps and 50 arcs. Mr. Low is well known as the electrical inspector of the Pacific Insurance Union, as a member of the electric committee of the Underwriters International Electric association, and as vice-chairman of the section of pure practice of the World's Congress of Electricians, held at Chicago.

NEW INCORPORATIONS.

Northwest Fixture company, Seatt'e, Wash.; capital stock, $12,000.

Meredith Electric Light company, Mered th, N. H.; capital stock, $6,000.

Larchmont Electric Light company, Larchmont, N. Y.; capital stock, $15,000

North Baltimore Water & Electric company, North Baltimore, O.; capital stock, $80,000.

Peotone Electric company, Peotone, Ill.; capital stock, $6,000; Henry A. Rathje, Peotone, Ill.

Electric Power company, Portland, Me.; capital stock, $500,000; to manufacture electric motors.

Colorado Springs Gas & Electric company, Colorado Springs, Colo.; capital stock, $150,000; J. A. Hagerman; Colorado Springs, Colo.

ELECTRIC LIGHTING.

An electric lighting plant will probably be established at Benton, Ark.

Work has been commenced on a new electric light plant at Momence, Ill.

Marblehead, Mass., is to establish an electric lighting plant as a result of a vote of the town recently.

The municipal authorities of Orense, Spain, are inviting proposals for the concession for the electric lighting of the town for 40 years.

At Baltimore, Md., the mayor in his annual message suggests that the city erect its own electric light plant at a cost of about $500,000.

The village of Ada, O., desires to negotiate with some responsible electric light company for lighting the streets of the village for a period of five years.

A company has been formed at Bilbao, Spain, to be known as La Sociedad Electrica del Nervion, to establish a central station on the left bank of the Nervion, opposite Bilbao.

The Co-operative Electric Light company, Chicago, has given a trust deed for $40,000, running for ten years, at 6 per cent. to the Royal Trust company, secured by the company's plant on the Old Ogden property on North Clark street, in the rear of the Newberry Library.

Springfield, Ill., citizens are still in conflict with the Electric Light & Power company of that place. The Electric Light company reduced the price of street lighting from $150 to $100, and the council now wishes it to reduce it to $80, threatening to erect a plant of its own.

The electric lighting concern which has been supplying arc lights of 2,000 candle power each, on moon table schedule, at Upper Sandusky, O., at the rate of $65 per annum per lamp, has tired of its generosity. A confession of utter inability to go on with the task was accompanied by a demand for $75 per lamp, and the council agreed to hereafter pay that sum.

The result of the re-advertising for proposals for public electric lighting in Brooklyn, N. Y., for the ensuing year—the first bids having been rejected as excessive—are as follows: Municipal Electric Light company, 1,200 candle power arcs, all night and every night, 40 cents per night; and the bid of the Citizens' Electric Light company was the same.

ELECTRIC RAILWAYS.

The Fair Haven, Conn., & Westville Street Railroad company will erect an electric plant at the cost of $500,000.

The receiver of the Piedmont Cable company, Oakland, Cal., has been granted his application to mortgage the road to raise $15,000 to pay operating expenses until a purchaser may be found. It is also rumored that a change to electricity is contemplated.

The annual meeting of the Short Electric Railway company, Cleveland, O., was held March 27th. The old board of directors was re-elected. The following officers were elected: President, B. F. Miles; secretary and treasurer, Bothune Duffield; general manager, S. M. Hamill.

It is said that a street car deal involving nearly $1,000,000 in money and eleven corporate companies has just been consummated by A. L. Johnson of Cleveland, whereby that gentleman obtains a monopoly of the entire street car system of Allentown, Pa. Mr. Johnson is reported to be negotiating for a franchise for 100 miles of street railway property in Brooklyn, N. Y., from Fort Hamilton to Thirty-ninth street ferry.

It has been decided by the directors of the Grand View Beach Railroad company of Charlotte, N. Y., to build a new depot and power house to replace the old one which burned last year. New electrical machinery will be purchased and the equipment will be of the latest type.

Electric traction is making progress in Germany. At present the Allgemeine Electricitäts Gesellschaft is constructing lines at Stettin, Nuremberg, Danzig and Spandau. The steam tramway which connects a number of the western suburbs of Berlin is to be converted into an electric line.

The Royal Electric company, Montreal, has brought an action against the Electric Street Railway company for $27,626, on the ground that the railway company's action in placing the return wires in its system underground had rendered the company's own wires useless. The Royal Electric company claims as damages the expense of placing new return wires above ground.

It is proposed in the near future to construct an electric tramway at Dublin, Ireland, from the terminus of the United Tramway company, at Dollymount on the North side, to Howth, and on the South Side from the Clonskeagh terminus to Dondrum and Windy Arbor. Parliamentary powers have already been secured for the line, and it is proposed to commence the construction immediately.

The wall, roof and machinery floor of the Consolidated Electric company's power house at Burlington, Vt., furnishing electric lights throughout the city and power for the electric railroad, fell in recently, ruining the building and machinery. The estimated damage is $50,000. The collapse was caused by the building becoming undermined by water. No one was seriously injured.

MISCELLANEOUS.

An exhibition of labor saving machinery driven by electric motors is being organized in Budapest.

Fire did considerable damage in the Waring Electric Lamp company's factory in the second story of the Mather Electric company's building at Manchester, Conn., last month The Mather company was the principal sufferer.

The subject of securing electric launches for Lake Harriet, near Minneapolis, Minn., is being discussed. It was stated before the park board which has the matter in charge that some of the launches in use at the World's Fair last summer could be procured at a comparatively small outlay.

A new French carriage, which carries six persons, is driven by an electric motor, receiving current from a battery of 54 Dujardin accumulators, and has a total weight of about a ton and a third. One charge of the accumulators, it is said, suffices for a trip of 44 miles at a speed of 10 miles an hour.

The repair shop of the Cleveland, O., Electric company, a one-story building, 100 feet long and nearly 100 feet wide, was burned to the ground March 21st. All the machinery which it contained, including several motors, was completely destroyed. The loss will aggregate about $50,000, covered by insurance.

The proposition to compel the burying of all wires, telephone, telegraph, district messengers, etc., in the downtown districts of Indianapolis is causing considerable comment, and is generally looked upon favorably. Steps will undoubtedly be soon taken to prepare a measure looking to the accomplishment of the movement.

An electric parcel van, built by E. J. Clubbe & Co., of Elm street, Gray's Inn-road, is now being tried on the London streets. The current is supplied by E. P. S. accumulators hung below the body of the vehicle. With one charge these accumulators, it is claimed, will supply the current for a 50-mile run, and they can be replaced with fresh accumulators in, it is said, a couple of minutes.

LEGAL DECISIONS.

In the case of the Electric Power company against the Metropolitan Telegraph & Telephone company the Supreme Court of New York held that a telephone company which cuts and carries away wires of an electric power company is liable for the conversion, although the telephone company had lawful authority to carry on its business, and the power company was not authorized to use its wires as it did, and although the telephone company cut the wires in attempting to comply with a notice from the Board of Electrical Control. Where the servants of the telephone company are ordered to cut the wires from its fixtures, and also carry away the wires, it is liable for the conversion.

The Supreme Court of Rhode Island says, in the case of Elliott against the Newport Street Railway company, that it does not think that the danger of being hit by a trolley pole is such a peril as a passenger whom the railway company has undertaken to corry on the footboard of its car is bound to anticipate and be on the lookout for, unless it appears that the passenger had knowledge of the close proximity of the track to the trolley pole. He has a right to assume that the railway company has performed its duty in so constructing its road that its passengers, even on the footboards of its cars, riding there by its permission, shall not be exposed to injury by the unsafe construction of its road.

"There can be no question at, this late day," says the Supreme Court of Wisconsin in the recently decided case of the state against the Janesville Street Railway company, "but that our municipal corporations may make all reasonable regulations for the location and use of electric wires in the street, and require all reasonable safe guards for the same. For example, a telephone company is entitled, especially under an ordinance providing for its being done, to sue out the writ of mandamus to compel an electric street railway company crossing its wires to properly place such gxard wires as the proper safeguard in such a case to protect its rights and safety, where it is admitted to be true that such guard wires so placed are the very best and most approved method of safeguard in such case."

A common carrier of passengers, operating its cars by means of electricity, is bound to use extraordinary care, and is liable for slight negligence. So holds the Court of Appeals of Colorado, in the recently decided case of the Denver Tramway company against Reid. This was an action brought to recover damages alleged to have been sustained by a man thrown upon an electric railway track, between the cars of a train, in such a way as to be dangerously shocked. The court holds that the fact being established that injuries were caused by electricity, and that the car was so charged with the current as to injure a person by contact with it, if not establishing negligence in itself, made such a *prima facie* case as to require defense to show that the injuries were not caused either by that agency or through the careless use of the agent.

It is an erroneous view of the law, holds the Supreme Judicial Court of Massachusetts in the recently decided case of Ellis against Boston & Lynn Railroad company, to hold that the manager of an electric railway car upon a street is never called upon to stop the car, or to change his method of managing it, to avoid any danger from the fright of horses other than the danger of collision with the car. The rights of the driver of a horse and the manager of an electric car, under such circumstances are equal. Each may use the street, and each must use it with a reasonable regard for the safety and convenience of the other. The motorman is supposed to know that his car is likely to frighten horses that are unaccustomed to the sight of such vehicles, while most horses are easily taught, after a time, to pass it without fear. It is his duty, if he sees a horse in the street before him that is greatly frightened at the car, so as to endanger his driver or other persons in the street, to do what he reasonably can in the management of his car to diminish the fright of the horse; and it is also his duty in running the car to look out, and see whether, by frightening horses or otherwise, he is putting in peril other persons lawfully using the street, on foot or with teams. It is also proper to consider the question whether a motorman ought to have seen the frightened condition of the horse in a given instance, if he did not see it, and to treat his failure to see it, when he might have seen it by the exercise of due care, as negligence.

TRADE NEWS.

The Kinsman desk light, for which the Central Electric company is general selling agent, is meeting with a ready sale, and the advantages of this light, which become apparent upon examination make for it many friends.

The Law Battery company of New York is presenting to its friends a unique pen and holder made of glass which has the advantages of a quill for easy writing. The orders for the gravity cell indicate an ever increasing demand for the products of the company.

A catalogue issued by Van Derwerken, Rickerson & Brainerd of Brooklyn, is replete with many new illustrations of electrical novelties. Special mention is made of their long distance telephone which is furnished complete, mounted on backboard. J. H. Mason has severed his connection with this company as electrician. H. J. Brainerd, for several years manager of the Payson Manufacturing company of New York, will act in the same capacity for this new concern.

The new catalogue of the Berlin Iron Bridge company, East Berlin, Conn., comprising over 300 pages, illustrating and describing iron buildings for machine shops, foundries, rolling mills, casting shops, electric light and power plants—in fact all classes and kinds of manufacturing buildings—is now ready for distribution. The expense of this catalogue has been so great that it will not be sent out broadcast, but will be mailed upon application to those interested in this class of work.

The electrical trade in Chicago is familiar with the compact and well arranged vest pocket directory which the Charles E. Gregory company, 47–49 Jefferson street is in the habit of issuing annually. It is the intention of Mr. Gregory to issue this year's directory about May 1st and he desires to have represented in it every concern in the electrical business in Chicago. The name, street address, and telephone number of the electrical houses in Chicago will be inserted free of charge if received prior to May 1st. This book in preceding years has been a handy and valuable local electrical directory and it will undoubtedly be larger and more exhaustive this year than ever.

China specialities has been made the subject of an illustrated hand book by Pass & Seymour for whom George Cutter, Chicago, is the general western agent. The success of Pass & Seymour in making china devices of difficult patterns has opened a new line of electrical devices for higher insulation and neater workmanship. The aim has been to make goods best suited to both the mechanical and electrical conditions, and the result is shown in the pages of this book. All of these goods are thoroughly vitrified and are noted for strength, finish and uniformity. They are made of the unusually tough Syracuse china, and are recommended by leading insurance underwriters as fully meeting with their approval.

Edward Lasell & Co., 225 Dearborn street, Chicago, manufacturers of the Monarch incandescent lamp, complete telephones and telephone apparatus and supplies, and general western agents of the Viaduct Manufacturing company, Baltimore, Md., have issued a complete handbook illustrating and describing their apparatus. Especial

attention is paid to their magneto telephone, from the users of which the firm has numerous testimonials of its worth. The business of Edward Lasell & Co., however, is not limited to these two specialties, but they are in a position to furnish all materials required for the construction of private telephone lines or exchange systems, magneto signal bells, testing bells, messenger call boxes, and messenger and fire alarm apparatus.

The Buckeye Electric company, Cleveland, O., calls attention in two circulars to its "special" coiled filament Buckeye incandescent lamp and to the railway incandescent lamps manufactured by the company. The first named lamp is small, compact and of pleasing design and is especially adapted for decorations, steamer lighting or household lighting. It is but 4¼ inches long, the standard type being 5⅜ inches Its small size makes it particularly valuable for steamer lighting and it has been adopted upon U. S. government war ships, Atlantic liners and many lake and river steamers. The railway lamps have anchored filaments and are made specially for electric railways. They are uniform in current as well as in voltage, burn brilliantly and give long life. The Chicago office of the Buckeye company is in the Monadnock building.

The Hayden-Booker Manufacturing company, 2140 De Kalb street, St. Louis, Mo., is sending the following circular to the trade: "The case of Charles W. Holtzer against the Consolidated Electric Manufacturing company has been decided in favor of the plaintiff. The judge in his opinion says: 'The defendant's battery appropriates the essential idea of construction contemplated by the first and second claims of Holtzer's patent, and is an infringement thereof.' An injunction was entered and an accounting ordered. The broad claim in the Holtzer patent is for a carbon element integral with a cover for the jar. The market has been flooded with cells, made in various shapes, but all posessing this one feature. The price of cells will now advance, as the manufacture will be restricted to makers who can work under this or other patents. The Holtzer decision does not effect us, and as our single cylinder cell possesses advantages not possible where the element and cover are integral, we welcome the decision."

BUSINESS.

George Cutter of Chicago reports a thriving business in the P and S china wiring tubes, which meet the new and more rigid inspection rules.

The contract for installing an electric lighting plant at the Arkansas Deaf Mute Institute, Little Rock, Ark., has been awarded to the Arkansas Electric Supply company.

G. W. Conover, western manager for the Perkins Electric Switch Manufacturing company, is satisfied from the many compliments received for the new Gibbs' switches that they will meet with a ready sale.

W. H. Stanley has leased the premises at 806 Walnut street, Philadelphia, lately occupied by O. D. Pierce & Co., and will keep on hand a large assortment of electrical supplies and will also carry on an electrical construction business.

The Manhattan General Construction company, 50 Broadway, New York, and Equitable building, Baltimore, has been appointed the sole agent in New York, Baltimore and their respective vicinities of the Buckeye Electric company, of Cleveland, O.

The Beacon Vacuum Pump & Electrical company, Boston, Mass., announces that it has reduced the price on its "New Beacon" incandescent lamp of 16 candle power in barrel lots to 25 cents. The output of this company has been materially increased, and the advancement that has been made in its improved lamp enables it to give the consumer the benefit both in quality and price.

James B. Waller, assignee of the Ansonia Electric company, Chicago, with his assistant, A. R. Waller, is working to close out the entire unsold stock as soon as possible, and a long list of electrical supplies may be inspected at the company's store rooms, Michigan avenue and Randolph street. The assignee has recently advertised asking for bids on the entire unsold stock of the insolvent company.

Anti-thunderbolt insulating paper, which is being introduced by J. Jones & Son, 39 Vesey street, New York, is meeting with considerable success. This insulating material is intended to resist heat, oil, water, dampness and the injurious action of chemicals and gases. It will not crack or tear when folded or formed to work. It is especially adapted for use on electric railway generators and stationary motor armatures and field coils and for general electrical manufacturing and repairing.

The Mica Insulator company, New York, is constantly adding to its line of micanite insulations. One of its most recent specialties in this line is a micanite insulation for rheostat boxes. This is an entirely new department, and many advantages may be seen to arise from the use of mica for this purpose. A new catalogue is in press and will soon be ready for distribution. The company, whose office is at 218 Water street, has put in a telephone, No. 968 Cortlandt. This will afford prompt communication, and an order received by the company will receive careful and immediate attention.

The annual meeting of the Brush Electric company took place at its offices in Cleveland, O., March 26th. General reports by the secretary and general manager were read. They indicated a prosperous business during the last year, despite the financial conditions which existed. The following officers were elected: President, W. H. Lawrence; first vice-president, C. A. Coffin; second vice-president and general manager, S. M. Hamill; treasurer, B. F. Miles; general counsel, W. B. Bolton; assistant general manager, L. H. Rogers; secretary, A. H. Hough; superintendent, C. W. Phipps; assistant superintendent, C. N. Black.

Experience has taught the underwriter to demand that 4 inches should be a minimum distance between the poles of a 500 volt cut out, when a current of more than 70 amperes is likely to be the fusing or limit point. It pays to see that the safety devices upon which so much depends are good and to remember that cheapness alone should not recommend an article. The Bryant Electric company has a 500 volt single pole cut-out designed in accordance with the suggestions of the underwriters. The cut-out is strong and well made. The western representatives of the Bryant Electric company, Thomas G. and Edward R. Grier, have a stock of these cut-outs on hand in their store room, Monadnock building, Chicago.

The Automatic Telephone & Electric company of Illinois, sole lessee of the Strowger automatic switch for Illinois, announces that it is actively engaged in the work of establishing its system in cities, towns and villages throughout the state, especially inviting the co-operation of local companies, believing that the large majority would prefer exclusive individual organizations, enabling them, as such, to retain the entire advantage of the system within their own community. The company is also prepared to construct private exchanges in office buildings, hotels, manufactories, etc., for which its system is admirably adapted. It will also sell long distance magneto-telephones.

The F. P. Little Electrical Construction & Supply company, Buffalo, N. Y., is calling attention to the Colvin interior telephone system for intercommunication between the several departments of public buildings, hotels, factories, etc. The system is sold outright and possesses many features which will tend to make it popular. A number of installations of the apparatus have already been made and trustworthy testimonials have been received expressing satisfaction with its operation. In designing its apparatus the Interior Telephone company has proceeded upon the assumption that every United States telephone patent, not already expired, is good, and it has therefore been as careful to avoid infringment of existing patents as it has been to adequately protect itself with patents of its own. The equipment is reliable, simple and neat in appearance.

The Electric Appliance company of Chicago is beginning its usual spring campaign on the swinging ball lightning arrester, and is meeting with considerable success. The company reports that the swinging ball lightning arrester has held the field for so many years that it does not now require any very aggressive campaign work to call forth a large demand for the specialty. The arrester is particularly adapted for a line arrester, and is almost exclusively used in this way. The manufacturer promises something new this season in a station arrester built upon an equally effective principle, and claims that an equipment combining the swinging ball lightning arrester on the line and its station arrester at the station will afford unfailing protection. The Electric Appliance company's new specialty, the Allen soldering stick, is meeting with the general approval of the trade and is already in large demand.

The American Silk Manufacturing company, 311 Walnut street, Philadelphia, manufacturer of silk wipers especially adapted for wiping dynamos and all fine parts of electrical machinery, is very much gratified with the large increase of orders for its wipers during the month of January, which were 100 per cent. larger than those of the previous three months, notwithstanding the fact that January is usually a very dull month in this line. A portion of this increase may be due, in a measure, to the fact that this company is now furnishing a new and improved compound for washing these wipers, which is very much superior to the compound furnished heretofore. The new compound is not affected by heat or air, and will in no manner injure the fibre, and is furnished free of charge. The American Oil company, of San Francisco, upon application, has recently been appointed sole agent for the Pacific coast, and has already sent in a large order. One of the leading cotton waste dealers in Pittsburg, Pa., has also sent in a gratifying order. The greater portion of the orders come from electrical firms.

The large and commodious quarters which the Central Electric company will occupy about May 1st at 173 and 175 Adams street, Chicago, after having undergone a complete and thorough re-arrangement and re-fitting, are rapidly nearing completion. The offices as at present will be located on the ground floor, and will be convenient and accessible. The office trimmings, counters, shelving, and in fact all the fittings of the establishment will be of antique oak, giving a decidedly rich and substantial appearance. The building will be complete in its electrical equipment, and the different sizes of the Lundell power motors, exhaust and ventilating fans will be exhibited in actual operation. The complete interior conduit system of wiring will be carried throughout, brass armored conduit being used with the new iron armored conduit for risers the details of which have been given much attention. The large factory which the Central Electric company owns and operates at Columbia City, Ind., for the exclusive manufacture of pins and brackets, has been running to its full capacity, the heavy construction orders which this company has recently received, having made it necessary to do so in order to fill orders promptly.

The General Electric company, mindful of the necessity of perfecting the wire it manufactures, as the exigencies of electrical practice become more exacting, has just placed upon the market a new rubber covered wire which is claimed to be superior to anything of the kind yet offered. This is known as the double rubber core wire. It has three coverings. Next to the wire inner core of a soft rubber, free from sulphur, protected by a second heavy covering of pure vulcanized rubber. Over this is a braided sheath, finished with a weather proof compound which serves to protect the rubber from the attack of acids, alkalies and from mechanical injury. Before applying the first covering the copper wire is thoroughly tinned to protect it from corrosion. The rubber coverings are made of the best grade of fine Para rubber. The wire is made with three standard thicknesses of insulation, although it can be of any thickness desired. The lightest is intended for ordinary electric light wiring and for use on circuits not exceeding 500 volts. The second for use on circuits not exceeding 2,000 volts, such as street railway, primary circuit, alternating and arc light circuits up to 40 lamps. The thickest insulation is for circuits up to 5,000 volts and is devised for high tension work. Wire with the last two insulations may be armored for any class of submarine work.

ELECTRICAL PATENTS

Issued March 27, 1894

517,017. Incandescent Electric Lamp. Richard P. Ashwell, Newark, N. J., and George W. Tuttle, New York, N. Y.

517,018. Secondary Battery. George L. Ballard, Toronto, Can.

517,028. Electric Railway Trolley. Frank S. Church, Detroit, Mich.

517,042. Electrode for Arc Lamps. Salomon Heimann, New York, N. Y.

The electrode is composed of a mixture of powdered ashes, carbon and a binding substance.

517,069. Electric Lamp. Frederick C. Rockwell, Hartford, Conn.

517,072. Phonograph. Hermann L. Sanborn, Brooklyn, N. Y.

517,100. Electric Switch. Jacob S. Gibbs, Hartford, Conn.

517,105. Electric Motor or Dynamo-electric Machine. John W. Henderson, Philadelphia, Pa.

517,127. Lubricator. John B. Purvis, Detroit, Mich.

517,134. Apparatus for Supplying or Removing Storage Batteries. William E. Worthen, New York, N. Y.

The car is provided with a detachable truck carrying the storage battery, and adapted to be attached to the car between the two end trucks. When it is desired to change the discharged for a charged battery the truck is detached and removed from the car by a platform adapted to be lowered beneath the surface of the road bed, a truck with a charged battery being then run onto the platform and raised into place and attached to the car.

517,162. Electrical Measuring Instrument. Rudolph M. Hunter, Philadelphia, Pa.

A pivoted frame is provided which is directly operated by an expansible body over which an electric current is passed. Secured to this frame is a compensating pointer or needle so arranged that for variations in atmospheric temperature surrounding the instrument the pointer will be moved under the influence of the expansible body in such a manner that the measuring instrument will be self-compensating and accurate.

517,163. Electrical Indicator. Arthur E. Kennelly, Orange, N. J.

The indicator comprises a magnet, a disk armature situated flatwise between the poles of the magnet and having a winding adapted to carry the current to be measured, and an indicating device moved by the disk armature.

517,169. Electric Appliance for Dumb Waiters. James H. Roberts, Brooklyn, N. Y.

517,170. Electric Heater. Lesley B. Rawley, Ashland, Wis.

517,214. Electric Ventilating Fan. Charles W. De Mott, Brooklyn, N. Y.

517,243. Single Line Telephone System. John I. Sabin and William Hamptor, San Francisco, Cal.

The operator's cap telephone is normally connected with the line, and the subscriber switches himself into circuit therewith by removing his telephone from its hook. By the act of connecting with the line the cap telephone is cut out and an indicator and battery are bridged between the two sides of the talking circuit, the indicator remaining actuated so long as the subscribers are in conversation, and becoming unactuated to signal the operator for disconnection when the subscribers hang up their telephone.

517,258. Electrical Railway. Benson Bidwell, Philadelphia, Pa.

517,263. Telephone Switch. Frank R. Colvin, New York, N. Y.

The telephone switch is provided with a telling hook or support for the telephone, the free end of the hook normally pointing upward, the angle of tilt to shift the switch to its abnormal position being sufficient to cause the hook to point downward to shed the telephone.

517,276. Metal Covered Elbow. Edwin T. Greenfield, New York, N. Y.

517,299. Electric Calling Apparatus. David Hall Rice, Brookline, Mass.

517,401. Circuit Closer. Charles E. Allen, Salem, Mass.

517,402. Electrical Keyboard. Charles E. Allen, Salem, Mass.

517,419. Electrical Apparatus for Controlling Signals. Michael B. Leonard, Richmond, Va.

11,408. Electric Elevator. Frank E. Herdman, Winnetka, Ill.

11,409. Electrically Operated Elevator. Frank E. Herdman, Winnetka, Ill.

Western Electrician.

EVERY SATURDAY.

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Electrically Operated Elevated Railroad Bridge.

One of the greatest problems, perhaps, that has taxed the ingenuity of the modern engineer, is the equipment of existing bridges with the electric motor. At least two instances of this kind occur in Chicago. The electrically operated bridge over the Chicago river at Rush street has already been described in the columns of this journal. The other application of this character is on the bridge used by the Lake Street Elevated Railroad company in crossing the river, an illustration of which is presented upon this page. The strains are so varied, the load so fluctuating, the motors necessarily subjected to all weathers and corroding gases arising from the Chicago river, that for some time the scheme of operating the city's bridges by electricity was thought to be a merely theoretical success. The city, after its successful operation of the Rush street bridge by a single motor, installed some years ago, of a special type selected by Prof. J. P. Barrett as being suitable for such heavy work, at last arrived at the conclusion that the experiments in this line should be tried on a larger scale, consequently a contract was given to the General Electric company to equip the Lake street bridge, a 300 ton bridge, with electric motors, the installation to consist essentially of two 25 horse power, on a constant load, and 50 horse power intermittent, 500 volt iron clad motors, specially designed for sudden strains, with armatures of the ironclad type. These motors were equipped with special gearing of phosphor-bronze, so arranged as to operate two lengths of shafting, operating the pinions at their extremities, which extremities were located on the edge of the turntable of the bridge and operate the gears which drive two vertical shafts, the lower pinions of which engage with the circular rack permanently fixed to the masonry of the bridge.

Up to July of 1893 the bridge had been operated by team, but from July to the present date the Lake street bridge has been operated by electricity, furnished from the power station of the Chicago Edison company, the current being delivered at 500 volts by means of a special armored cable sunk under the river from the shore to the center of the bridge; the cable consisting of three conductors, one positive, one negative and one spare conductor, which conductor, in case of accident to one of the other two in operation, can be utilized in place of the injured conductor.

The motors are controlled from the center of the bridge in the operating house by means of special rheostats, band brakes and reversing switches. The rheostats used are of the radial form, built up of plates of sheet iron insulated with mica, set into a cast iron frame, so that the resistance boxes are practically incombustible. From the experiences of the city with regard to this bridge the practicability of operating the city bridges by electricity has been fully demonstrated; the saving consisting principally in the constancy of the electric power, in the small cost of repairs, and in the general simplicity of operation, requiring the minimum amount of expenditure in labor to operate; in fact, the labor being such only as is required from any watch tower superintendent.

It should be borne in mind that this bridge not only supports and turns its own structure used for the carrying of teams and passengers, but, in addition, carries the heavy steel structure over which the Lake Street Elevated Railroad company runs its heavily loaded trains. It has been stated that it is a 300 ton bridge, but the superstructure on which the elevated railroad company runs its tracks is an addition, so that the total weight of the bridge exceeds 600 tons. On the addition of the structure of the elevated railroad company, the city decided, that in order to bring the ends of the bridge to the right level of the rails it would be necessary to install on the bridge an extra motor, of 15 horse power capacity, of the same iron clad type as those previously installed for the turning of the bridge, which motor was to operate a shaft, which, in turn, was to operate lifting jacks to raise the ends of the bridge to the proper level, so that the passing trains might feel no jar in crossing the bridge.

The operating house is electrically lighted, and an electric system of signalling between the operator and the two flag men, whose duty it is to raise the rails, which overlap upon the bridge structure previous to the bridge being drawn, has been adopted. The system is so arranged that the operator's bell will not ring until both men, one at each end of the bridge, have given the signal that they have taken the necessary precautions to block the trains coming from either direction. No indication is given the operator if only one man delivers the signal, which prevents him from misunderstanding signals and opening the bridge before all precautions have been taken.

ELECTRICALLY OPERATED ELEVATED RAILROAD BRIDGE.

Overhead Trolley Lines for Chicago.

The Chicago city council at its meeting on April 4th took action upon the trolley ordiances recently passed in the interest of the South Side cross-town lines, and returned by the mayor for amendment. The mayor submitted his views in a message to the council together with several proposed amendments. Representatives of the city and street railway company had endeavored to reach an amicable settlement, but without success. Here are the recommendations of the mayor:

1. Iron or steel center poles, whenever the width of the street will permit; iron or steel side poles in narrow streets.

2. An independent electric return circuit for the protection of the water and gas pipes in the streets.

3. No trolley lines on Archer avenue east of the river or on Twenty-second street, these streets being too close to the heart of the city.

4. The space between the poles to be not less than 115 feet, the distance determined by the council in the case of the Lincoln avenue and Milwaukee avenue electric roads.

5. No right to use any other motive power but

electricity without the previous consent of the city council.

6. Poles for the conveyance of wires from the power houses to be erected in alleys wherever feasible.

7. No right to lease the use of poles or wires to any other companies without the previous consent of the city.

8. No interference with the surface of the streets except upon a cash deposit of the amount of the possible cost of the restoration of the streets as estimated by the commissioner of public works.

9. Rails used to be subject to the approval of the mayor and commissioner of public works.

10. Limiting the franchises to a term of ten years so that they will expire about the same time as the general franchises of the company.

11. Proper provisions of indemnity to the city for any damages sustained.

12. A provision for lighting the streets affected by these ordinances with electric arc lights to be attached to each of these ordinances.

13 Payment of $250,000 to the city as a contribution for the expense arising from track elevation and to defray the increased cost of deepening the subways so as to accommodate trolley cars to be made a condition of each ordinance.

14. Limitation of the franchise to the Chicago City Railway company so as to exclude successors, lessees and assigns.

15. Amendments in matter of form rather than in matter of substance.

The aldermen paid very little attention to the mayor's recommendations and passed the ordinances in practically the form proposed by the railway company. Some slight alterations were made, however, and this gave the mayor another opportunity to veto the ordinances which he did on Monday evening. Much attention has been attracted to the controversy over the trolley ordinances and it is said the mayor hopes the new council, elected last week, will sustain him in his fight against the ordinances in their present form.

On Monday night when the mayor again returned the ordinances to the council without approval, the whole subject was referred to a committee for the purpose of conferring with the street railway officials and reaching some agreement.

Electricity at the Midwinter Fair.

The opportunity which the California Midwinter International Exposition afforded for exhibiting the products of manufacturing interests was taken advantage of by a number of electrical concerns which made a display at the World's Fair and were desirous of still further advertising their apparatus in this manner. Among these the Western Electric company, Chicago, may be credited with making a very interesting and artistic display. The company

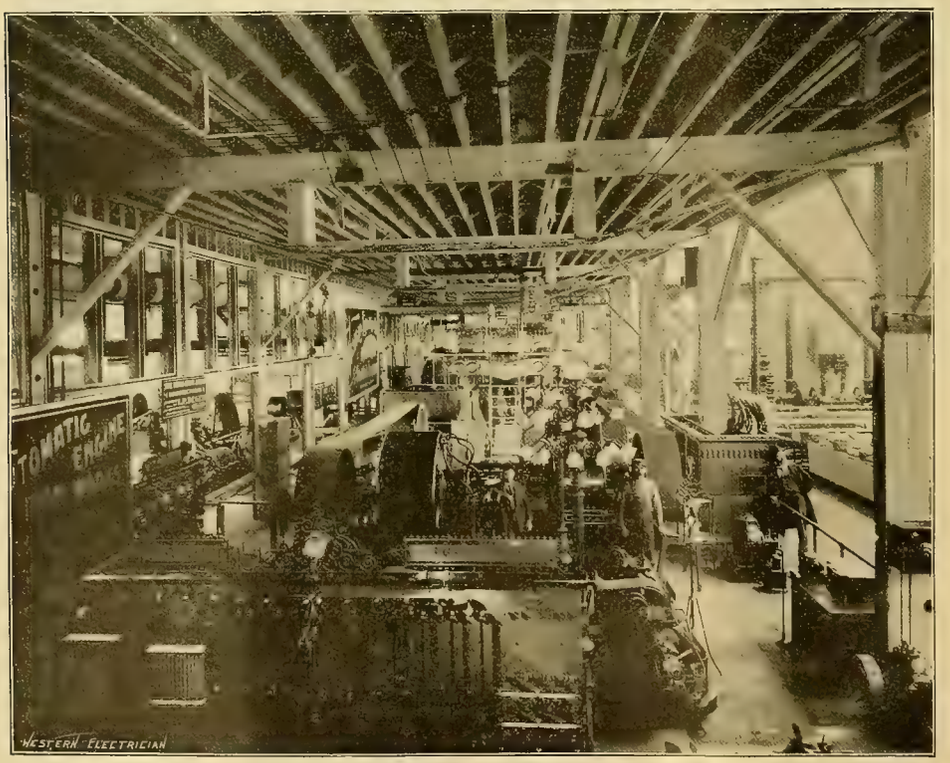

FIG. 1. ELECTRICITY AT THE MIDWINTER FAIR.

obtained the contract for supplying much of the current for lighting effects, including that used in lighting the central feature of the fair—the electric tower. The exhibit attempted by the Western Electric company is in general a practical one, although a number of those attractive novelties seen in the company's section in electricity building at the World's Fair attract much attention from curious Californians. Of its many lines of manufactures the company sent to Golden Gate Park only dynamo electrical apparatus, including generators, both bipolar and multipolar, switchboards, indicating and controlling instruments, etc., embodying everything necessary for arc and incandescent lighting or power plants.

The ground occupied by the exhibit, with the engines

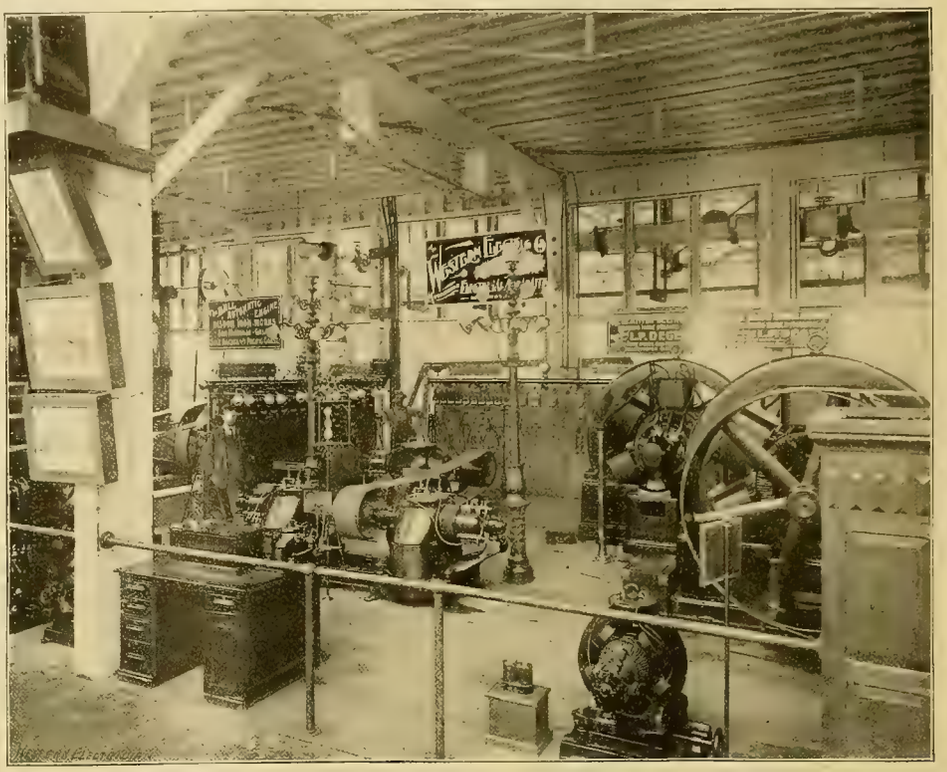

FIG. 2. ELECTRICITY AT THE MIDWINTER FAIR.

driving the generators, includes nearly one-half of the space devoted to electrical exhibits in the main mechanical arts building, and a block about 40 by 50 feet in the annex to the building. The apparatus shown, of which a general view is presented in Fig. 1, includes two 150 kilowatt multipolar generators, which deliver current at 250 volts pressure for operating about 3,600 16 candle power incandescent lights upon the electric tower which shines each night in the center of the grand court or plaza of the exposition. A 600 horse power compound engine of the vertical or marine type, manufactured by the Union Iron Works company of San Francisco, running at about 180 revolutions per minute, is belted directly by two 21 inch belts, to each of the two 150 kilowatt multipolar generators driving them at 250 revolutions per minute.

An interesting feature of the exhibit from a mechanical standpoint, is the group of three small machines shown in Fig. 2. The shafts of two 30 kilowatt machines are in common alignment and direct coupled by means of a common pulley keyed to both shafts. This pulley is connected by link leather belting to an 80 horse power 500 volt motor. During the day time when only 500 volt current is available, the 80 horse power motor drives the two direct coupled machines which both act as generators, one machine generating current at 110 volts pressure, utilized in the operation of the electric scenic theater on the Midway, the other machine generating current at 220 volts pressure, supplying current to electric motors used by exhibitors in the various buildings on the grounds. At night the two 150 kilowatt multipolar generators, also shown in Fig. 2, are in operation and then the 500 volt motor is disconnected; the 220 volt machine, used as generator in the daytime, is used as a motor for driving the 110 volt generator as well as the 500 volt 80 horse power motor, which in case of necessity can then be turned into a generator of small capacity to supply 500 volt current. Under these conditions the large generators also assume the motor load of the exposition, which during the day was supplied by the smaller generator.

The Western Electric company also exhibits four 50 light arc dynamos of the bipolar type, not shown in the illustrations, which are used exclusively for lighting the manufactures and liberal arts building of the exposition. Two complete switchboards, each about 14 feet long, one for incandescent and the other for arc lighting service, are a portion of the exhibit. The boards consist of polished, red Tennessee marble panels, highly ornamented with brass trimmings. These, together with all the instruments, including ammeters, voltmeters, switches, rheostats, in fact, all controlling devices necessary for complete electric plants, are in Japanese copper finish, and their appearance excites the same general admiration that was granted them while exhibited at the World's Fair in Chicago. All instruments and every piece of apparatus in the entire exhibit, are of Western Electric company's manufacture.

There is also to be seen a number of ring-type motors manufactured by the company, and several attractive novelties, among which is the company's writing sign, which was exhibited at the world's fair last summer, displaying a moving arm which to all appearance automatically lights and extinguishes incandescent lamps arranged to form the inscription "W. E. Co." A card writing machine which mechanically writes the company's name upon cards distributed to the visitors also excites much interest. It is operated by a small electric motor and illustrates the company's facilities for designing and building its own special automatic machinery for special applications. A Western Electric

search light or head light conspicuously calls attention to the company's space by sending its rays over the entire building from its elevated position directly in front of the exhibit. The display is made complete in detail by numerous attractive novelties, among which are illuminated pictures of prominent buildings lighted by the Western Electric company's systems of lighting, and a number of artistic incandescent lamp stands and fixtures with 100 or more incandescent lamps. The entire display is operative, all the apparatus exhibited being in motion and performing service.

The electric scenic theater, which is operated as one of the midway attractions, is equipped entirely with controlling and regulating apparatus of the Western Electric company's manufacture. The sunrise and sunset effects storms, lightning, rainbow and starlight effects, together with all the shifting lights and shades occurring in the cycle of a day, are reproduced to perfection, and form as pretty and attractive a picture as that which interested so many at the World's Fair. The entire installation was designed and installed under the supervision of the Western Electric company's representative, E. W. Goldschmidt.

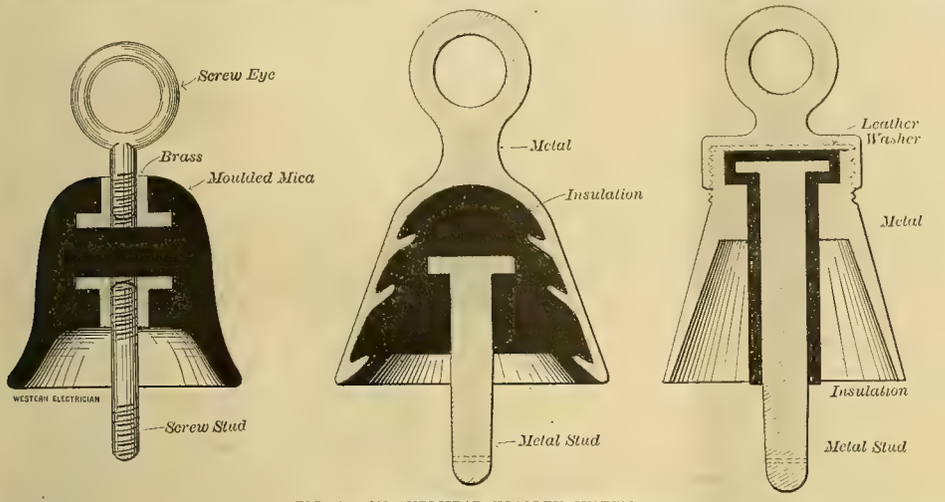

FIG. 1. AN OVERHEAD TROLLEY SYSTEM.

An Overhead Trolley System.[1]

By O. M. Rau.

This much abused, although silently welcomed system, has received considerable attention from inventors and street railway managers within the last few years. Through their combined efforts a point of perfection has been attained, where, it is safe to say, no radical improvement will follow, and a system constructed on the standard of to-day, will not be much out classed by future construction. Not only is there little room for the perfection of an overhead trolley line, but the minds of the inventors are now taken up by the underground and storage battery systems, and the drift in improvements for electric street railways will be in these directions.

The maximum success which an overhead trolley system can attain has been reached, and capitalists need no longer wait in deciding to use this system, expecting to see it brought to a higher point of perfection.

The improvements from the first overhead line to the present form of construction has been astonishing. Yet to the untrained eye it appears the same eye sore as the first one put up, and it must be admitted that very little has been done to improve its general appearance. This could be accomplished with little expense, by artistic poles and neat wiring, which would do a great deal toward its approval by the public. The main efforts in improvements have been to make it safe and reliable. The system of three years ago is like a flimsy spider web compared to the heavy structure of to-day. Instead of a No. 4 or 6 trolley wire a No. 0 is used; instead of poles made of gas pipes, a special drawn steel or lattice pole is used; and instead of making the material as light as possible, it is made strong, without reference to weight.

The system of poles for a trolley road is still much discussed, and between side and center pole construction there is so little preference that it is impossible to adopt any one as a standard. Local conditions must determine which to use. The side pole has in its favor the small cost of maintenance, but the greater first cost has prevented its use on suburban lines and the opposition of property owners to having poles in front of their houses, as well as the hindrance to the fire department, have proven serious objections to its use in the business portions of cities, and the center pole has been adopted wherever the streets are wide enough to allow poles to be placed between the tracks. The main advantage of the side pole system, as stated before, is the limited cost of repairs which is mostly due to the flexibility of the system. The span wire suspension forms no rigid construction, and there is a certain amount of slack which will give under the pressure of the trolley wheel, thus avoiding the sudden blow to the trolley clamp, keeping the wheel in more perfect contact with the wire, and reducing the liability of the wheel jumping. The life of a trolley wheel is considerably increased by these advantages, as the tension on the trolley base spring need not be so heavy, and the friction is reduced both on bearing and periphery of wheel. These advantages lead to the adoption of the side pole system where a large number of cars are operated, which would warrant the extra expense of this construction.

The preference of city authorities, as well as by property owners, is for center pole construction in the business portion of cities. A thoroughly constructed center pole system should not be any more expensive to maintain, with the exception of wear on the trolley wheels, than the side pole system, and if the poles are of neat design and well maintained, their presence will not affect the appearance of a street, and certainly will prevent ambitious drivers from occupying the whole roadway. The danger of the poles being close to the cars is very slight, and, up to the present time not a serious accident has been attributed to this cause.

The cars must be provided with gates on the inside platform, whether side or center pole construction is adopted, as the danger from jumping in front of a car running the opposite direction is equally as great as coming in collision with the poles. By having these gates well secured, any accident from this source is avoided, and the danger from bridges, where the truss construction comes very close to the cars, is far more serious than from the center poles.

For first-class construction, as well as embodying neat appearance, lattice or built-up iron poles have proved most substantial. This pole is very strong, and, at the same time has enough elasticity to prevent its bending from any sudden blow or strain. The poles well set in concrete, about six feet in the ground, will keep a trolley line from getting a staggering appearance, and there is nothing that improves the looks of a pole line more than systematic construction. For side pole, the lattice type is much used, but a heavy tubular form is also convenient. The setting of these poles should be similar to center poles, but should have a rake in the opposite direction to the strain and should be fitted with an insulated pole top.

The span wire is a very important part of this plan of construction and should be insulated from the ground and securely fastened with provisions for taking up slack. These requirements are easily met by mounting the pole with a hardwood top, usually of maple, well painted, through which a hole is bored for an eyebolt with a thread, so that by tightening a nut, it will draw the eyebolt through the pole top and tighten the span wire, which should be of ¼ inch galvanized steel cable.

The trolley wire bell or insulator, of which there are about as many styles as there are men selling them, form the principal item of expense in the maintenance of an overhead system, and this should receive the most careful study before a specific bell is adopted. Of the numerous forms, some of which are herewith illustrated, the only satisfactory one, from a financial point of view, is the metal covered form shown at the right in Fig. 1. It should have means of fastening to the span wire or center pole cast on the outside shell. This will do away with additional parts as well as screws or eyebolts.

For span wire work, the standard form, conventionally called a straight line hanger, is the most suitable and quickest to hang. The center pole has given occasion for various patented forms to be placed on the market, such as placing springs between the bell and pole arm, and other devices to form a flexible connection between the pole and hanger, to do away with the rigid fastenings when simply bolted to the pole; but of the numerous forms I have tried, they not only proved too expensive, but of very little value in aiding the flexibility of the line.

A fastening very much employed for center poles, is the swivel joint which allows the bell to swing forward or back, as the trolley wire may have occasion to draw it. This has given rise to a large number of trolley wire breaks, as the clamp holding its position at right angles to the bell will draw the trolley wire out of a straight line, and when the bells hangs at an angle the end of the clamp is presented to the approaching trolley, which, in a very short time, will have nicked the wire so that it will break. This plan of fastening was made necessary from the large number of clamp studs or screw eyes which would break when the bell was bolted to the pole rigidly. The improvement made in overhead parts has changed this, as the screw eyes and studs are either done away with entirely or increased in size, so that they will stand any reasonable strain. When the bell is fastened as a rigid fixture to the pole and the trolley wire held firmly in it, each pole will receive its own share of the strain from the wire and need only take care of the span between it and the next pole. In this manner the bells will remain at right angles to the trolley wire and the clip or clamp will always remain in a straight line. The clamp or clip is, perhaps the most troublesome to decide on, although a selection between a mechanical clamp or a soldered clip is usually in favor of the former. A soldered clip, although giving the neatest appearance as well as the smoothest surface to the trolley wheel, is expensive to put up and interferes considerably in repair work, which unless done with the utmost care, will be a continual source of trouble. In fact any device which require soldering, is not to be recommended on a trolley system. The average line man is not careful enough with this work and will invariably over-heat his solder, which will soften or anneal the wire more in this spot than elsewhere, resulting, when under strain, of its drawing out at this point, making it thinner and ultimately breaking. This is most noticeable in the soldered sleeve, and over 20 per cent. of trolley wire breaks can be traced to the beating of the wires during soldering. A mechanical clamp, to be substantial, should have as few parts as possible, be free from screws or nuts, and hold the wire firmly without interfering with the trolley wheel. There are numerous patented devices to attain these effects, but nine-tenths of them have too many parts, are too weak, or cost too much. A very important feature which has been overlooked in most mechanical clamps, is the corrosion of the threads on the studs or screws which form the means of holding the clamp to the wire, and, in numerous cases, I have seen where the clamp had to be cut in pieces in order to get it off the trolley wire. The stud in the bell should be extra heavy, not less than ⅝ inch, as this is very likely to break. For center poles, this stud must be especially strong, as the strain on this part of the hanger is very great and the number of line patrol calls is greatly governed by their strength. It is, perhaps, interesting to see what a difference this simple little stud makes to the patrol department of an extensive electric railway system. From the record sheets of a line having about eighty miles of road and about 4,000 bells on center poles, a total of 3,700 cells were recorded for the year 1893–94. Of these, 3,230 were to replace bells on which either the screw eye on top or the screw stud on the bottom of the bell had broken. These were 7-16 inch in diameter. From this it is apparent that almost every bell on the system was replaced during a period of one year. With proper construction, on a center pole system, there should not be more than one hundred calls per one thousand bells per year, or a depreciation on the system of about ten per cent., not including value of bells taken down, which can be repaired or used again. The exposed position of the hangers has favored the use of brass for the metal used in the material, but this simply

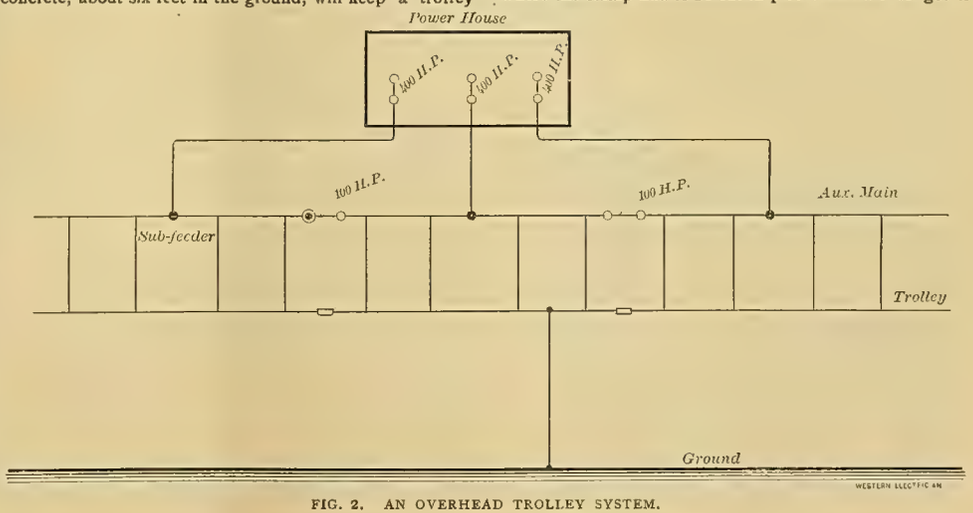

FIG. 2. AN OVERHEAD TROLLEY SYSTEM.

1. Read before the Wisconsin Electric club, Milwaukee, Wis., March 30, 1894.

increases the expense, and is of no special benefit, as the strength of malleable iron is far superior to that of the cheap grade of brass generally used, while the corrosion is insignificant on these castings.

The sizes of trolley wire used in the evolution of electric street railways has now arrived at a standard, and it is peculiar to note that the first road operated, used the present standard size of wire, which is No. 0 hard drawn copper. The experiment of using Silican bronze of small gauge has proven a very costly line to maintain, besides increasing the wear on the trolley wheels. The wear on a trolley wire, on straight lines, is imperceptible and should last at least ten years without re-wiring, and with good road beds and rigid inspection of trolleys, the breaks should not exceed one per mile of double track road per year.

An important, but not much used plan for trolley wire system, is the auxiliary main distributing system, Fig. 2. This auxiliary main of No. 0 insulated copper wire is usually run along the top or side of center poles, and at intervals of 600 feet is connected by means of a No. 4 flexible wire, termed sub-feeds, to the trolley wire. The connection is made by a sub-feed clamp. This is the ordinary clamp provided with a lug and set screw to firmly

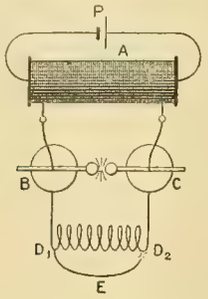

FIG. 1. D'ARSONVAL'S HIGH FREQUENCY EXPERIMENTS. PRINCIPLE OF THE APPARATUS SHOWN IN FIG. 2.

clasp the sub-feed wire, making a connection through the clamp with the trolley wire. The advantages of an auxiliary main are very numerous. By its means a more equal distribution of power is obtained, the connection at switches and crossings need not be relied on to carry the current and the drop on long lines is overcome, which otherwise would have to be wired with a larger size trolley wire. It is especially useful in carrying the current over crossings of other lines or where the trolley has to be insulated through a circuit breaker. The expense of adding this auxiliary to a trolley line is very small and should not be omitted in an extensive system. The distribution of the current to an electric railway has not received the attention that it should, and a great many roads simply take the ends of the trolley wire and connect them to the station bus bar and let her go. A thought of equalizing the potential is never entertained; yet, every one knows a motor built for 500 volts, cannot operate with efficiency on 350 volts, but this is very commonly the case near the ends of a line, and in many instances this drop can be avoided to some extent without the addition of copper by a proper plan of distribution. In a system covering an extensive area, where feeders to different sections are used, a very interesting study can be made of feeding sections to obtain the best results in accordance with the number of cars and other local conditions. This I have carried out in a very extensive plan on the system of this city. There are twenty-one feeders to distribute the current over a radius of three miles from the power house and supplying current for forty miles of double track.

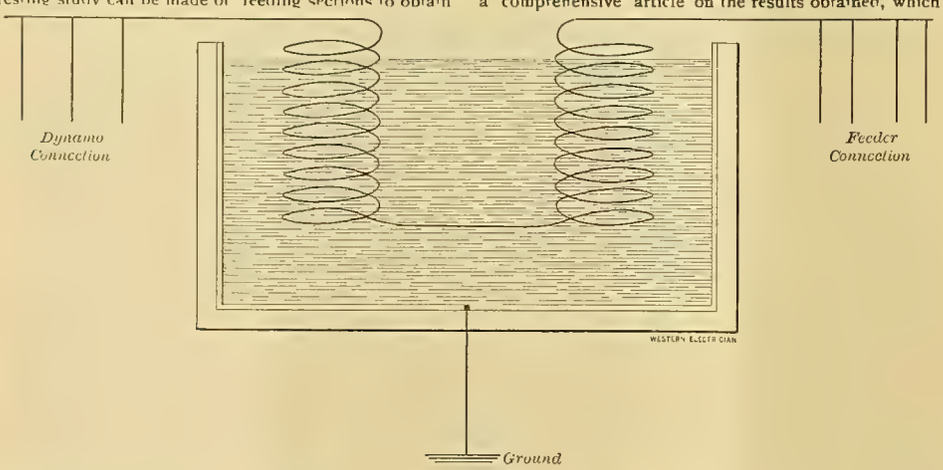

FIG. 3. AN OVERHEAD TROLLY SYSTEM.

The original plan of feeder sections was probably laid out theoretically according to the size of the feeders and the distance they had to feed. By taking potential readings during the operation of the road, I found, in some instances, a drop of 25 per cent., while the calculated drop should not exceed ten per cent.; and on another feeder, but two or three per cent. where ten per cent. was allowable. By changing the sections so as to obtain the largest area of copper, or make a loop circuit for one feeder section, and by arranging the sections accordingly to the profile of the road, this excessive difference of drop was considerably equalized, although there was still some difference in the potential of different sections and could be easily noticed when passing a circuit breaker from one section to the other. The advantage of having the line in sections is very important; a trolley wire breaking or other accident to any particular section, will only delay that part of the system. Yet the only way to equalize the pressure over the entire system is to have all the feeders connected together as one large web work, similar to an illuminating distributing system, where the mains would resemble the trolley wire. To obtain this advantage, I placed a fuse box between each section, with a fuse ¼ of the carrying capacity of the main fuse on the feeder in the station. The fuse was fully capable of carrying all the current necessary to equalize the pressure between the adjoining section and still be so light as to blow, if the plug or fuse in the station was out. In this manner a wire down or other ground would blow the station fuse first, this supplying most of the current feeding the ground. After this is blown, the light fuse at the section would blow immediately, leaving the grounded section dead. The repairs to the system would be made without greatly delaying the operation of the road. The potential over the entire system is equal and it would be perfectly feasible to supply current for lights and motors for commercial use from the trolley wire system.

Another important part of an overhead system is the apparatus for protection from lightning. In plants where an extensive overhead feeder system is in use this is a troublesome enemy, and the safest trap for it is a tank arrester at the station, Fig. 3. This was perfected by A. Wurts, and consists of a coil of heavy wire placed in a metal lined tank, filled with water and connected with a perfect ground. The total current generated is passed through this coil before it is distributed through the feeders. Any lightning discharge which follows the wire is obliged to pass through this coil, and, as lightning will be opposed by induction in attempting to follow around the coil, it will prefer to take the path through the water to the ground. This arrester has proved very efficient, and, although a slight loss is continually going on through the water to the ground, this is not objected to, as the tank need not be filled with water except during storms. For trolley line protection, a number of lightning arresters have been devised, although but few embody the requirements for an out-door arrester. To protect a large system against lightning, requires about one arrester for every mile of trolley wire, and, considering the distance covered by a trolley system, an inspection, at intervals, of this apparatus is out of question. Thus, a lightning arrester, suitable for line work, must be non-arcing, have no movable parts about it, or coils which can burn out, and must be enclosed in a weather-proof box with suitable outlets for connecting wires which should be large, and perfect connections made to the trolley wire and track.

In closing, I will say that, although the overhead trolley wire system has been abused and, as often remarked, has seen its day, the next generation will see more overhead trolley lines constructed than lines of any other system, and for cities from 200,000 or less population, it has come to stay.

D'Arsonval's High Frequency Experiments.

Much attention has been attracted by the high frequency experiments conducted by Dr. D'Arsonval and additional interest has been awakened by the publication of a comprehensive article on the results obtained, which is contributed by M. Guillaume in *La Nature*, from which the accompanying illustrations and abstract are taken:

"We know that under certain conditions an electrical discharge becomes oscillatory. A very simple apparatus the principal of which was borrowed by Dr. D'Arsonval from Dr. Lodge's experiments on lighting conductors, enables discharges of this nature to be produced, and an essential property of currents of high frequency to be shown. A Ruhmkorff coil, *A*, shown in Fig. 1, serves to charge through their inner armatures two Leyden jars, *B*, *C*, connected in cascade; the discharge which is produced between the opposite balls is oscillatory; the potential of the external armatures varies with the same frequency, but the current, in a wire which connects them, varies more suddenly than in the circuit containing the spark. If we connect the external armatures by a bobbin, D_1, D_2, consisting of 10 spirals of thick copper wire, they will be short-circuited for an ordinary current, and we should only keep up a difference of potential of a few volts between the armatures by sending into the wire a current sufficient to volatilize it instantaneously. But here the intermittent discharge shows its peculiar nature; it has an invincible repugnance to enter the wire. The reason of this is very simple; the extremely rapid variation of potential (thousands of volts in the hundred-thousandth of a second), which is set up at the terminals of the bobbin, produces currents varying with formidable rapidity, and consequently endowed with enormous inductive power. The induction of each spiral acts upon the adjacent ones, and the resulting current tends at each moment to annul the primary current, so that only a small fraction of the current passes. It is of no use in this case, to calculate with resistance as defined by Ohm's law; we have to deal with quite a different antagonistic force, a combination of resistance and induction, to which the name of impedance has been given. This is the sum of the impedimenta opposing the course of the current. In the case we are considering, the impedance resolves itself practically into the antagonistic force of induction.

"We can, in the following manner, show how reluctant the oscillatory discharge is to enter the bobbin. On applying a wire, *E*, to its extremity, D_1, and bringing it near the last spiral, D_2, we shall see in the space between the wire and the bobbin a sheaf of sparks formed, more than a centimeter long; thus the discharge will more easily

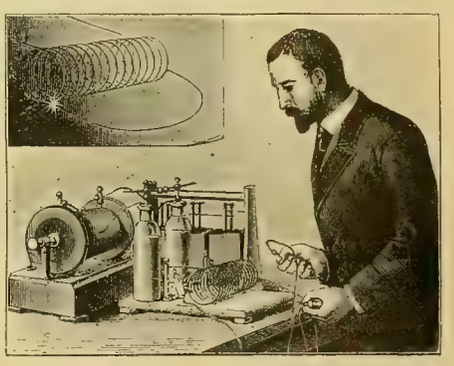

FIG. 2. D'ARSONVAL'S HIGH FREQUENCY EXPERIMENTS APPARATUS FOR THE ELEMENTARY STUDY OF THE OSCILLATORY CURRENT AND FOR THE DEMONSTRATION OF IMPEDANCE.

traverse one centimeter of air, than a resistance which can practically be disregarded, but which possesses induction.

"What will happen if we touch the extremities of the bobbin? Apparently we shall receive the entire discharge, accompanied by so great a shock that, following the example of one of the greatest electricians, we would not repeat the experiment for the kingdom of France. To our great surprise, we feel not only no shock, but not even the slightest tingling. Has the discharge again changed its course? No, for if, instead of touching the bobbin at the two ends, we content ourselves with holding near to one of them a piece of metal held in the hand, we see the sparks reappear. What is more, we can introduce an incandescent lamp into our circuit, and we shall see it light up briliantly, Fig. 2. The current therefore passes through our body without our feeling it, thus showing another of its peculiarities. To what then is its harmlessness due? The first idea that occurs to us is that the current passes entirely over the surface of the body into the epidermis and the clothes. There is no doubt a certain amount of truth in this explanation, but this localization of the current is not the only cause of its harmlessness. Dr. D'Arsonval's researches have shown that the neuro-muscular phenomena increase in intensity, with the frequency up to 3,000 alternations per second, remain to all intents stationary up to about 5,000 alternations, and then decrease, and soon cease altogether. A frog's leg is insensible to Hertz's alterrator, as M. Joubert has shown. And yet the physiological action of these currents is far from being *nil*, its passage into the tissues is accompanied by the following singular effects: 1. If for a certain time we close the current through the hands, which are provided with large metallic conductors, we find that the skin has become insensible. This insensibility lasts from a few minutes to half an hour. 2. Under these conditions, if we insulate ourselves on a glass stool, taking one pole only, we experience a sensation of heat which is accompanied by copious perspiration and considerable vascularization of the cutaneous surface 3. Lastly, if we make a little wound in the foot of some animal so that the blood only escapes drop by drop, we find that the hemorrhage becomes very abundant under the influence of the current. There is therefore a powerful force at work tending to dilate the vessels.

"The current, therefore, passes through the body, but the nerves have become insensible at this frequency. The experiments that we have just described may be made with the little apparatus which we have already described; but a more powerful installation enables the effects to be greatly increased without their being modified in any essential particular. Fig. 3 shows the larger apparatus; instead of the bobbin, we have a transformer supplied by an alternating current dynamo; the discharge spark of the Leyden jars, instead of being given off in the open air, is produced in a powerful magnetic field; it is thus expanded into a luminous circle, and produces a deafening noise. We light, as shown in the figure, not one single lamp, but a whole series of lamps, which the operators hold in their hands without their being metallically connected with the apparatus. Referring to this experiment, M. Cornu said at the sitting of the Academy held on July 3, 1893: 'There can be no doubt as to the enormous quantity of energy passing through our body; transmitted under the form of a lternating currents with long periods (from 100 to 10,000 per second), it would have been sufficient to kill us; under the above conditions, it produced no appreciable sensation.'

In all the experiments of which we have spoken, the oscillatory current, generated in a metallic circuit, was utilized either for its physiological effects or for its physical action; but, as we have seen, the current possesses enormous inductive power. Why, then, should it not produce induction directly on the living tissues? Each particle of the body, or of the part under treatment, would thus become the seat of an electromotive force, and the whole body, or one part of it, would be uniformly penetrated by the currents which originate in the very heart of its tissues. This is what Dr. D'Arsonval shows by means of the following experiments: We see in Fig. 4 an operator with a lighted lamp on his forehead. This lamp, which is mounted on a single wire, is separated by a distance of a few centimeters from a crown with which it has no direct communication. This latter, which is traversed by the oscillatory discharge, develops in the ring the current required to feed the lamp. It is clear, therefore, that the head itself is traversed by similar currents.

The existence of the currents produced by auto-conduction in the human body may be rendered evident by a conclusive experiment. If the operator places his arms round a solenoid, as shown in Fig. 5, forming a circle completed by a lamp, the terminals of which he holds in his hands, the lamp will be seen to light up. A similar phenomenon will be produced if the patient is enclosed in a solenoid Fig. 6.

"The measurement of currents of very high frequency of course necessitates the employment of new methods. That which was suggested to Dr. D'Arsonval by chance during an experiment is not yet perfected, but it at any rate enables us to note the currents used, and reproduce them at will. The currents induced in the conductors give off heat, which is the measure of their energy. All we have to do, therefore, is to make the induction act on a mercury thermometer, and note the elevation of temperature, in order to get an idea of the intensity of the inductive current, if the frequency does not vary much.

We see at the top of Fig. 3 (No. 2) the arrangement for the experiment; the thermometer is placed in the axis of a little solenoid, traversed by the oscillatory discharge. In a moment we see it rise 150 or 200°.

We have already obtained from currents of high frequency results that could not possibly have been foreseen four or five years ago. Some engineers think that they have an immense industrial future."

General Electric Company's Report.

The second annual report of the General Electric company has been issued. The statement covers the year ending January 31st. It is an interesting document, and some of the figures presented are herewith reproduced:

ASSETS.

Patents and franchises		$8,159,264
Manufacturing plants		3,941,128
Real estate (not including factories)—		
Edison building, New York City	$412,356	
Less mortgage thereon	200,000	
	$212,356	
Other real estate	111,329	
		323 685
Stocks of manufacturing companies	$2,767,470	
Stocks and bonds of local companies	2,723,493	
		5,490,963
Cash	591,143	
Notes and accounts receivable (face value $14,984,697.42)	8,934,159	
		9,525,303
Inventories—		
At factories	3,349,042	
At sales offices (including consignments)	1,485,749	
		4,834,792
Work in progress		1,198,343
Profit and Loss		12,454,967
Total		$45,928,449

LIABILITIES.

Capital stock—		
Common		$30,459,700
Preferred		4,251,900
Five per cent. gold coupon debenture bonds		10,000,000
Mortgages		26,200
Accrued interest on debenture bonds	$ 83 333	
Notes payable	744,341	
Accounts payable	323,084	
		1,150,759
Sundry credits		39,889
Total		$45,928,449

The profit and loss statement is as follows:

DEBTOR: Interest on debenture bonds, $499,893; dividends, $1,655,150; taxes, $195,457; World's Fair expenses, $241,877; total, $2,592,378. Amounts now charged off: Patents, $733,870; notes and accounts receivable and on stocks and bonds sold and on hand, $10,444 318; manufacturing plants, $902,058; inventories and consignments, $2,157,507; machinery, tools, instruments, and fixtures other than at factories, $224,205; sundry losses, $125,205; total, $17,179 845.

CREDITOR: General Electric company's surplus, January 31, 1893, $1,024,954; manufacturing and selling profits, less general expenses, $3,189,884; dividends and interest on stocks and bonds owned, $433,293; interest, discount and exchange, $76 745; debit balance carried forward, $12,454,967; total, $17,179,845.

In reviewing the changes that have been made during the last year, attention is called to the fact that district offices have been closed and the policy of the organization is very much changed. Reference is made to "grave mistakes" in the value placed on accounts, etc., in the last annual report. Many changes are noted in the value of stocks, etc., and in explanation the report calls attention to the general depression in business during the year. Furthermore it says:

As you are aware, the Thomson-Houston company had large interests in various construction and manufacturing companies, notably the above-mentioned Northwest company, the Fort Wayne Electric company, the Brush Electric company and others; the whole standing on its books at about $5,500,000. At the time of the last annual report, statements were obtained from the officers of such companies, and it was estimated that something less than one-half of this investment was represented by patent rights, and something over one-half by other assets. Unknown to your board of directors, some of the companies became unduly expanded during the winter and spring of 1892-93, and the stringency which began in April and culminated last autumn caused them to suffer greatly. Your directors have reduced your entire holdings of Fort Wayne and Northwest stocks to a valuation of $1 each, exclusive of the amount carried in patents. After protracted negotiations the Northwest company has been put in liquidation, and the territory controlled by it has reverted to your company.

One fact of special significance is the shrinkage in value of $2,382,012 of apparatus and material, which is explained to be due to the fact that they have been superseded by improved types. The notes and accounts receivable represent dealings with over 6,000 customers, and include $2,531,609 due by the Fort Wayne, Northwest and other allied interests. The stocks of manufacturing and other companies placed in the balance sheet at $2,767,157, have a par value of $8,279 706. Other stocks of the par value of $6,037,310 are placed at $313; stocks of local companies (par value $2,750,313), $1,362,294; stocks of other local companies (par value $3,713,617), $4,754; bonds (par value $2,785,940), $1,356,431; others (par value $146,621), $12.

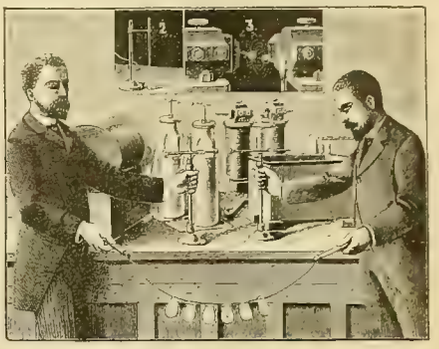

FIG. 3. D'ARSONVAL'S HIGH FREQUENCY EXPERMENTS. APPARATUS FOR THE PRODUCTION OF INTENSE OCILLATORY CURRENTS. (1) GENERAL VIEW OF THE APPARATUS; (2) ARRANGEMENT FOR MEASURING THE CURRENT BY MEANS OF THE THERMOMETER; (3) VIEW OF THE SPARKS IN A MAGNETIC FIELD.

The schedules from which these figures are taken furnish some idea of the magnitude of the interests involved The number of local and manufacturing companies in which the General company is interested is simply astonishing. It is claimed that the system of accounting and management has been greatly simplified since the offices, etc., were concentrated at Schnectady, and that during the last six months there has been a reduction of debt of $6,750,000. The report continues:

This reduction does not disclose all the improvement of the last six months. The indirect obligations of the company, arising from its indorsement of discounted notes receivable, were six months ago almost as embarassing as its direct debt, as the larger part of them had to be provided for by your company at maturity, their makers being unable to take care of them. To-day no paper is under discount except such as it is believed will be paid by the makers; consequently the interest obligations of the company are nominal rather than real. At the date of this report (April 2) the direct obligations have been reduced to about $750,000.00, which was partly offset by about $400,000.00 cash on hand, and the paper under discount is reduced to about $750,000.00

FIG. 4. D'ARSONVAL'S HIGH FREQUENCY EXPERIMENTS. AUTO-CONDUCTION; A LAMP LIGHTED BY INDUCTION ON A SINGLE WIRE.

FIG. 5. D'ARSONVAL'S HIGH FREQUENCY EXPERIMENTS. AUTO-CONDUCTION; A LAMP LIGHTED BY THE CURRENT INDUCED IN THE ARMS OF THE OPERATOR.

FIG. 6. D'ARSONVAL'S HIGH FREQUENCY EXPERIMENTS. LAMP LIGHTED BETWEEN THE HANDS OF AN OPERATOR PLACED IN A SOLENOID.

The Danish government has given its approval to the establishment of a telephone line between Copenhagen and Berlin, proposed by the German post and telegraph department, provided the line shall pass through Odense, so as to form part of a line between Odense, Kolding, Hamburg and Berlin.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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NEW YORK daily papers seem to have forgotten the "deadly trolley" in their consternation over the pranks of the Broadway cable. The *Tribune* calls upon the grand jury to indict the cable system as a nuisance. It seems to be under the impression that Chicagoans have been more fortunate in their experience with the "shoe string" system. The *Tribune* will receive new light on the subject if it consult Mr. Yerkes' patrons.

THERE seems to be considerable dissatisfaction over the failure of the English government to respond promptly to the demand that it guarantee the interest, or at least a certain percentage of it, upon the proposed Pacific cable. It is claimed that this failure on the part of the home government is severely interfering with the progress of the cable project in the colonies and in Canada. The postal conference at New Zealand recently voted to guarantee the interest at 4 per cent. upon $9 000,000 to be devoted to the building of the cable. In the case of one colony, however, the vote was conditional upon the home government sharing this responsibility. It is quite probable that this will be done, although up to the present time there has been no sign of interest on the part of the home government.

IN the annual report of the patent commissioner several timely suggestions are made with a view of improving the service and adding to the standing and authority of the department. It is proposed as far as possible to establish a division for the classification and systematizing of the records so as to make the scientific and patent literature complete and accessible. Such a library would not only facilitate the work of the office, but it would make the search work much more thorough and satisfactory. During the last year the receipts of the office amounted to $1,242,871.64, and the expenditures were $845,403.36. There were 23,670 patents issued in 1893, and 99 reissued. The number of applications for patents was 38,473.

Whatever criticism may be made of the patent system in this country, it must be admitted that there has been marked improvement in the management of the office of late years, and that every effort to improve the service and raise the standard of the department has been earnestly advocated by the commissioner and his associates.

THE elevated railroad interests of Brooklyn have secured the introduction of a bill in the Legislature providing for the regulation of the speed at which trolley cars can be operated. Their object is to reduce the speed of the electric cars now running on over four hundred miles of track in the city, and thereby to divert traffic to the elevated railways. With trolleys slower than horse cars, these capitalists and speculators would increase the value of their elevated railway stock and franchises. That is the main motive of this legislative raid against the surface railways in Brooklyn. The elevated companies do not claim that there is any demand for this regulation on the part of the people. It is significant that this measure has no local support in Brooklyn. The Kings county delegation is opposed to it. If enacted it would work great injury to the business interests of the city, and cause serious inconvenience to all residents in the outer wards and country towns. It would substitute slow for rapid transit and lay off one-third of the cars now in use. This would be done for the sake of enriching speculators and politicians who are interested in the competing elevated railways. There is no possible justification for the enactment of this bill. When electric power was introduced in Brooklyn there were many accidents, but the number has steadily diminished, and the system is now satisfactorily operated. Improved brakes have been supplied, racks have been attached to the cars, and the motormen have been trained to their work. Electric cars are now operated as safely in Brooklyn as in any other American city, and the speed is not excessive and dangerous. The elevated railway men, however, assert that they have been compelled to build a very expensive structure so as to get the right to operate at high speed, and they protest against permitting surface road companies to enjoy the same advantages free that they could only get by expending enormous sums. It is to be hoped that the senate committee on railroads will not report the bill which it now has before it.

IMPROVED street railway service on the cross-town lines in the South division of Chicago can only be had by the introduction of an electric system. The City Railway company, which controls these lines, has signified its willingness to comply with the demand of the people for better service, and it has promised to equip the lines, now operated by horses, with electric motors, provided the city grants it the privilege. Ordinances have been passed by the council providing for the proposed improvement and they have been vetoed by the mayor. At the council meeting a week ago the mayor submitted a message in which he gave his reasons for objecting to the ordinances. His suggestions are summarized elsewhere. At last week's meeting very little attention was given to the suggestions, the aldermen disregarding the most important provisions which the mayor insisted should be incorporated in the franchises. One of these was that the company should pay $250,000 into the city treasury and the other that it should light the streets upon which it operated its trolley cars. It is said that the company will not accept an ordinance loaded with these terms and it is also reported that the mayor will not approve a grant that does not contain these provisions. The controversy over these points may delay the improvement and possibly prevent its accomplishment for some time. The company is making money operating the lines with horses and is not anxious to expend such a large sum as would be required for the electrical equipment if it can avoid it. This was shown by the plain statement of Mr. Allerton who is one of the largest stockholders in the company. With the company lukewarm and the mayor bitterly opposed to the change, the proposed trolley system may be indefinitely postponed.

In his attack upon the company the mayor does not confine himself to the subject of the ordinances under consideration. He calls attention to the fact that the company's investment of over $13,000,000 is rated at only $500,000 by the South town assessor, and it is on this valuation that the company is taxed. While it cannot be denied that a valuation of 1-26th is not a fair basis upon which to levy the taxes of a big corporation which is amply able to pay its just proportion of the city's expenses, still the fault lies with the city official who makes the assessment and the system of city government under which such injustice is possible. Yet it is to be hoped that such an important improvement as the securing of rapid transit for the South side cross-town lines shall not be delayed by outside considerations. The subject has been before the council long enough, and it is to be hoped that the committee to which it was referred on its return Monday night will be able to effect a satisfactory arrangement with the company, which will ensure rapid transit for the South division.

THE second annual report of the General Electric company which has just been issued is quite a remarkable document and contains more information about the affairs of the concern than has heretofore been obtainable from official sources. The policy of retrenchment and economy introduced some time ago in the management is now well in operation and with the concentration of the offices and shops at Schenectady it is believed the affairs of the company will soon show marked improvement. An examination of the balance sheet and the schedules of stocks and bonds held by the company shows that there has evidently been an effort made in compiling this report to avoid repetition of the "grave mistakes in the estimates of value of accounts, schedules and inventories," which marked the first statement of the company, issued a year ago. Securities representing the company's interest in many local concerns and manufacturing companies are considered of no value whatever or of very little worth. Of course some of the shrinkage in values is attributed to the general business depression. Referring to this feature the report says: "It is needless to say that the past year has been a most trying one to all corporations. It has been especially so to companies like your own, dealing with local enterprises situated in all parts of the United States, and largely dependent on normal conditions for their success and development. During the summer of 1893, even old and strong customers were obliged to ask for leniency in paying their accounts and notes." This made it necessary for the company to dispose of a large amount of securities and these were sold at a sacrifice at that time. The directors do not believe that it will be possible for some time to come to do as large a business as was done by the company prior to the panic, although a gradual improvement has been apparent during the last two months. The report says: "The street railway business, which to a considerable extent was formerly done through syndicates and promoters, many of whom have become embarrassed, promises to be smaller than during the previous year. Arc lighting business is also reduced, largely because of the inability of local companies to secure capital with which to extend their business for the purpose of carrying out municipal contracts. The business of the company, with respect to incandescent lighting, which is to a great degree performed by strong and conservatively managed local companies, is in a more healthy condition and has not suffered so severely." Power transmission and mining work presents a promising field.

It is evident that the company has in no way modified its policy regarding patent litigation. The report refers to the incandescent lamp and street railway cases that have been tried during the year and says in the two instances in which the company met reverses "there is a strong probability that we shall ultimately prevail."

It will probably be a relief to many of the employes to learn that the company has about finished the work of cutting down the force of subordinates. The directors think that "a general appreciation of this fact will lead to more efficient work than was possible during the transition period." Altogether the report is a very interesting document and will receive more attention than any financial statement that has yet been issued by an electrical company.

Liverpool Overhead Railway.

The papers read before the Institute of Civil Engineers on the Liverpool Overhead railway which were published in abstract in the WESTERN ELECTRICIAN, March 31st, were followed by an interesting discussion, opened by Sir William Forward, chairman of the Board of Directors of the Liverpool Overhead railway. The following report is taken from *Industries:*

SIR WILLIAM FORWARD: In the 10 months the railway had been opened it had earned sufficient to pay the preference dividend and one per cent. to the shareholders, and it was mainly owing to the traction employed that this success had been arrived at. It was intended, originally, to have had steam traction, and he had visited New York to see for himself. After much consideration and deliberation they had decided upon electricity, but not without many misgivings, for they found that steam traction would cost £37,000 as against £7?,000 for electricity, but having made up their minds, they went for the very best, and he was sure that their success was due to this. When the contract was given out they stipulated that the contractors should run the trains for two years at a stated sum per train mile. The results were gratifying, and although they paid them 4d. per train mile, they had been able to pay a dividend. They had carefully watched the contractors, and finding at the end of 10 months that a good thing was being made out of it, the company stepped in and took the whole undertaking over, and for the month of January they had saved £ 150 in the working, the cost being equal to 3⅛d. per train mile, and their engineers said that when the whole line was open they would further reduce this charge. As to the reliability they had to be extremely regular as to time, as there was a very enterprising line of omnibuses running immediately under the railway which carried passengers at 1d. per mile, and if the railway were not punctual or it had many accidents they would then soon find the traffic reverting to the omnibuses. They were running a five minutes' service and their average was 96 per cent. on time, and during the week before last 99 per cent. were on time, a result which was not to be equalled by any railway in the kingdom.

He wished before sitting down to add his thanks to Sir Douglas Fox, Mr. Greathead and Mr. Parker for their help, as there was a time when the directors felt timid, but their engineers gave them confidence, and from what they said he felt sure that when the line was completed they would be able to pay a five per cent. dividend.

SIR. DOUGLAS FOX: The problem was now solved, but it was mainly, he thought, through those at the head of affairs being keen men of business, and knowing what was wanted, and communicating this to their engineers. It was true that the line was short, but the experience was intricate in the extreme, for the railway threaded its way among roads, warehouses, under railways, over dock entrances, and besides this they had the Liverpool authorities to deal with. As there was a large yard available at the north end of the line, the delivery of all materials had to take place there, and although at first sight it might appear that this was an expensive way of working, experience has decidedly proved the reverse. The directors required them to build an economical and durable structure, and above all things fire proof, for they were running in the midst of an inflammable neighborhood, and there had been several fires near the line, but no damage had been done to the structure. They were also like most engineers tied for head room and they were obliged to introduce under bracing. His colleague and himself had had many consultations as to the best design for a structure of this height, and they came to the conclusion that a girder of fifty foot span should be the normal one, but such were the difficulties of the road that only one-third of the spans were normal, and two-thirds abnormal; they thought they might have used a normal span, but had to go to the abnormal. The railway had cost £90,000 per mile, and £100,000 had been spent in slewing bridges, diverting lines and repaving roads underneath. With regard to the platform on which the trains ran, they had to make up their minds to have one which was practically noiseless, easy to paint, stiff, and tending to help cross bracing. After a great deal of consideration they had finally agreed to use Hobson's system, and this had given great satisfaction, the tests being remarkable. One other point they had to consider, that in a railway running among the streets it required to be "drop-dry," and the meeting would appreciate the sorrows which fell on them, but he was glad to say they had been very successful. He might tell them that it was necessary when using asphalt not to put any sand in it, for the work was then not reliable. The whole structure had given wonderful stiffness, and was much quieter than had been anticipated. Referring to the foundations of the piers, they had no less than 1,200 of these, and if they had been at all luxurious they would quickly have heard of it, so they adopted concrete, fixing the holding-down bolts into it and bolting securely to the columns, also putting in cast-iron bases which prevented damage from wagons. Mr. Huddlestone had told him only a week ago that during the whole year there had been no settlement, thus showing they had not overloaded the foundation. He thought that they might fairly claim that the whole structure at £90,000 per mile was not extravagant for a double line.

With regard to the parapet, they were compelled to adopt something of this sort, and running from end to end, so as to enable passengers to walk from the cars to the stations, which were fairly close together, should the motive power fail them at any time. The Board of Trade would have compelled them, he thought, to take some such measures. He would also point out the way this parapet was made, and the use they had found for it to pass compressed air through some of the tubes, and although it was cheap it did not rattle in any way. He would like at the next meeting to give the tests of the platforms. One thing that he felt sure was, that they must have plenty of stations on the railway, as the public would soon desert them if they had to walk far, and they, therefore, had no less than 13 stations on the line that was open, and intended to have 16 when the whole line was completed. The most important item, he thought, was the small amount spent on each station. They were double and strong and averaged complete £2,500 each. He drew attention to the swing bridge at Stanley Dock, as it was really a two-road bridge, and beside being a swing bridge, it was a bascule one as well, to enable barges with masts being taken out without swinging the bridge. There were several other bridges to allow for boilers, etc., passing under the railway, and they were made in tilt form and were found to answer very well. The cost of them was small, but they were handy.

SIR DOUGLAS FOX: The tests of the Board of Trade inspection, which occupied four days over the 600 spans, were as follows: Four fully loaded trains were used, equal to 13 hundredweight per foot of way, on the 40 feet spans the deflection was ⅛ inch, on the 75 feet spans ¼ inch, and on the Stanley bridge, where the weight was increased by four Lancashire & Yorkshire engines, equal to 30 hundredweight per foot of way, together with the load overhead of the four fully weighted trains, making in all four tons per foot of way, the deflection was only ⅜ inch. When dealing with the question of hauling power, the great difficulty they had to contend with was that the Dock Board would not permit the use of locomotives within their walls, as the sparks were considered to be dangerous, and so stringent were their regulations that they would on no account permit smoking within the premises of the board, therefore any hope of using steam traction was at once abolished. With regard to the use of cables they had no gradients except at the place where the line dipped under the L. & Y. railway, and there was the fact that the cable was always running which added very much to the expense of upkeep; besides they could not attain the speed they required. Their conclusions came rapidly to the use of electricity, and they were now more than satisfied with the results which had so justified the selection. To make electricity pay they must have short trains at short intervals, and he thought this suggestion might be adopted on the metropolitan lines with success. The cost had been stated to be £91,000 per mile, and it was made up in round numbers of the following items: General works, which included all the superstructure, bridges, etc., £59,000; stations and their equipment, £4,000; plant, which included the generator station complete £7,700; rolling stock, £5,000; accommodation works, such as diverting and alternating the roads below the railway, etc., £13,800; and the Acts of Parliament, inspection, etc., £4,400. He concluded by expressing the view that this railway would be the forerunner of many, that trains of 200 tons as against 40 tons would be running in the near future, and that all that had been accomplished at Liverpool tended towards this result.

MR. HEDGES: He could speak from experience with regard to Canada, which had some 300 miles of electric railway, he referred to the electric railway on the Canadian side of the Niagara Falls, which was 11½ miles long, and which ran from Chippewa to Queenston, and which was fairly level until it came just outside Queenston, where the gradient was one in 21. He was told that in some places it was one in 19; there was no difficulty in getting the cars up. They used motor cars having two motors on each car, and sometimes they added train cars to supply the needs of the traffic. He might say that, after all that had been said and written with regard to the proposals by the United States to utilize the falls for motive power, Canada had successfully applied this force to run the railway he mentioned. The turbines were placed 60 feet down in the solid rock, and all the discharges were made into the falls, so that there was nothing to disfigure the scenery. The cost of producing the power in the United States did not compare with that at Liverpool. M. R Guillaume had informed him that at Kansas City, where the railway was like the Liverpool one, and 20 miles long, that the cost was 12.9 cents, or 6½d., per train-mile. At Denver, where the cars run by cables, the the cost was 14 cents, or 7d., per train mile.

W. H. PREECE: Nearly all the lines in America were worked with the overhead wire and trolley system, a system which, he thought, disfigured the look of the cities very much indeed, and quite spoilt them to his way of thinking. He thought that it was possible to use underground. One feature in the United States was the mistake of commencing with too light a rail. He heard that 30 to 39-pound rails were originally employed. Now 60-pounds and even 70-pounds to 90-pounds were commonly used. He did find one fault with the Liverpool plant, and that was the return to rope driving. In the United States all modern plants work the dynamos direct, and with very few exceptions this was the practice in that country. That was the only flaw he could find with the whole plant, which, taken as a whole, was much in advance of anything in the United States. He had said that if a full and constant load could be maintained, if the current were produced for electric lighting it would be equal to gas at 2d. per 1,000 cubic feet. Now at Liverpool they only employed the current for 12 out of the 24 hours, and the paper stated that the cost was 4d. per train mile; this shows a cost of production of eight-tenths of a penny per mile, which was equal to gas at 5d. per 1,000 cubic feet, the energy for the train being applied as electric lighting experiments, which shows his figures to be nearly true. The greatest economy would be with a full and constant load. Mr. Parker had said that they lost only two or three amperes in leakage of the mains from the generating station. He might say there were some very interested people in Liverpool who might find great trouble from this leakage, notably the postmaster-general, whose wires ran in every direction, and that if the leakage were to increase to 200 amperes then there would most likely be trouble not only from the postmaster-general, but also from the gas and water companies. It was this leakage that in America compelled the use of overhead cables. He had studied the paper very closely, and he noted the objection the Dock board took to sparks from locomotive engines. Well, what about the sparks from the conductors—would they not be as dangerous? With regard to the cost of the application of electricity to the overhead railways in New York, this was a clear case, and showed how easy it was for an engineer to make his estimate so as to spoil a plan when it met with the approval of his superiors. It was said that £711,000 was required to equip a line equal in length to that of Liverpool, which cost £450,000—or 95 per cent, in excess of that at Liverpool—and that the cost of running was estimated at 3s. per train mile, as against 4d. in this country.

ALEXANDER SIEMENS: The question of the economy of the motor cars as against electric motors was one which had to be settled, in his opinion, with regard to each particular case, but he thought that, using only two motors on each car, and two cars only, there was no complication, but when more cars had to be employed, then trouble would arise with the switching. Reference had been made in the tables to the electric motors of the City & South London railway. The engines thus referred to would draw two more carriages than at present in use, but which could not be adopted owing to want of accommodation in the city. These engines weighed 13.5 tons, which of course altered the figures very considerably. He thought that the loss of energy which took place at the starting of the train might be lessened in this way: to have a motor generator and to supply a current of 2,000 volts, put the generator at low volts and work the motors on the axles. The cost would not be any more expensive than to supply the electric-motor with 500 volts direct, but this latter system is preferable, as it was simpler.

He would reassure the Dock Board as to the sparks from the conductors, which were only particles of iron and which would never cause fire as their heat was gone almost instantly. He further thought that 88 per cent. efficiency for rope driving was too high. Mr. Parker did not do himself justice with regard to his figures of 12.3 miles of the Liverpool line as against 12.9 miles of the City & South London line, the watts per train-mile for about the same weight being 32,650 in the former as against 21,000 in the latter. He felt ture there must be some mistake, as the motors at Liverpool were surely as efficient as those in London. The quick service of trains was the most desirable, and it was imperative to have a constant service to produce the best results.

MR. BLACKWELL spoke as to the visible conductors as against the underground ones, and said that the latter cost £7,000 per mile, while the former only £700 per mile, and in every case had the latter been a financial success; this was the reason why the overhead wire and trolley system was almost invariably adopted in the States, and at the present time over thirty millions of money was applied in electric traction there, and there was entire satisfaction and success as to the working.

Electrical Interests in Rochester.

The following abstract from the annual report of the electrical committee of the Rochester, N. Y., common council will be read with interest:

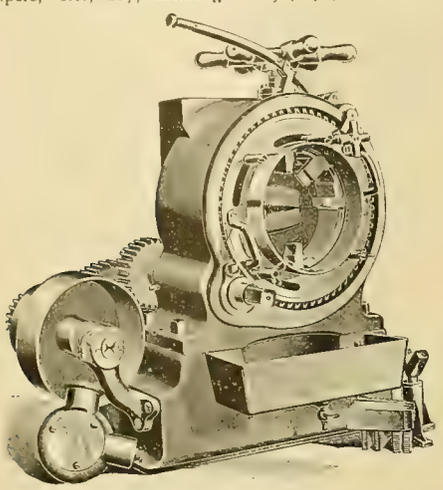
There are to-day 3,975.25 miles of wire used by all companies doing a business in which the electric current is used, divided among the companies as follows: 2,686.5 miles are used by the telephone company; 302 miles by the Western Union and Postal Telegraph companies; 502 miles by the Rochester Gas and Electric company, the Citizens Light and Power company and the Central Light and Power company; 196.5 miles by the Rochester Railroad company; 252 miles by the city for municipal purposes, and a number of lines owned by private parties for telephone and telegraph purposes. Of this amount 1,990.75 miles are underground and 1,984.75 miles overhead. The number of poles on the streets of the city are 8,584, of which the Western Union Telegraph company own 310, the Postal Telegraph company 190, the Rochester Gas and Electric and Brush companies, 4,334, Citizens Light and Power company 40. Rochester railroad company, 1,820.

The Western Union and Postal Telegraph companies have each one main office; in addition to these there are seventeen branch offices located in different parts of the city for the accommodation of their patrons. Connected with the telegraph business there are 1,002 call boxes for the purpose of calling message boys.

The telephone company operates 1,282 telephones in this city, 166 of which are connected to the central office by metallic circuits with no other instrument on the line. There are thirty-six (36) metallic combination lines with more than one instrument on same line; 857 are connected by grounded circuits direct line. There are 63 grounded circuits combination line. There are 58 long distance and 1,224 ordinary telephones in use. There are 39,958 incandescent and 3,131 arc lights, including street lights, used in the city, of which the lighting companies furnish 28,493 incandescent and 3,659 arc lights; 472 arc and 11,465 incandescent lights are operated by parties owning their own plants. The average amount of power used for motor purposes, exclusive of the street railroad use, is 1,063.5 horse power; this amount being delivered to 1,257 motors. Of this amount of power the light and power companies furnish 633 horse power; 43 horse power being furnished by private parties. The Rochester Railroad company operates 73.63 miles of track, 105 is the average number of cars run using an average of 2,600 horse power. This company has a plant of 3,000 electric horse power capacity; The total amount of electrical energy used in this city for

light and power purposes is 10,487 electric horse power. There are seven firms doing an electrical contracting business in the city. These firms do all classes of electrical work from putting in an electric door bell to installing the largest electric plants.

There are 1 034 persons directly connected with and earning a livelihood in the different branches of the electric business in the city. These are divided into the following classes: Managers and superintendents, 24; engineers, 48; firemen, 17; dynamo men, 37; bookkeepers and clerks, 30; telegraph operators, 47; telephone operators, 28; inspectors, 7; motormen and conductors, 377; repair men, 42; linemen, 64; trimmers, 41; drivers and helpers, etc., 107; messenger boys, 73; members of



FORBES' PATENT DIE STOCKS.

electrical contracting firms and men employed by them, 95.

The construction and maintenance of the electric lines and appliances in this is fully as good, if not better, than the same class of work done in other cities. Hoping the same high standard will be maintained for work done in the future, your committee congratulates the various companies and firms who have done the electrical work in the past on the quality of such work, it being done in such a manner that fatal accidents are very few, and the losses from fire caused by the electric current small.

Forbes' Patent Die Stocks.

In the accompanying illustration is represented what is known as the No. 3 F hand or power machine, a new development of the familiar Forbes' patent die stock, manufactured by Curtis & Curtis, Bridgeport, Conn. It has a number of new features and it both cuts off and threads all sizes of wrought iron pipe from one inch to six inch right hand inclusive. When this same machine

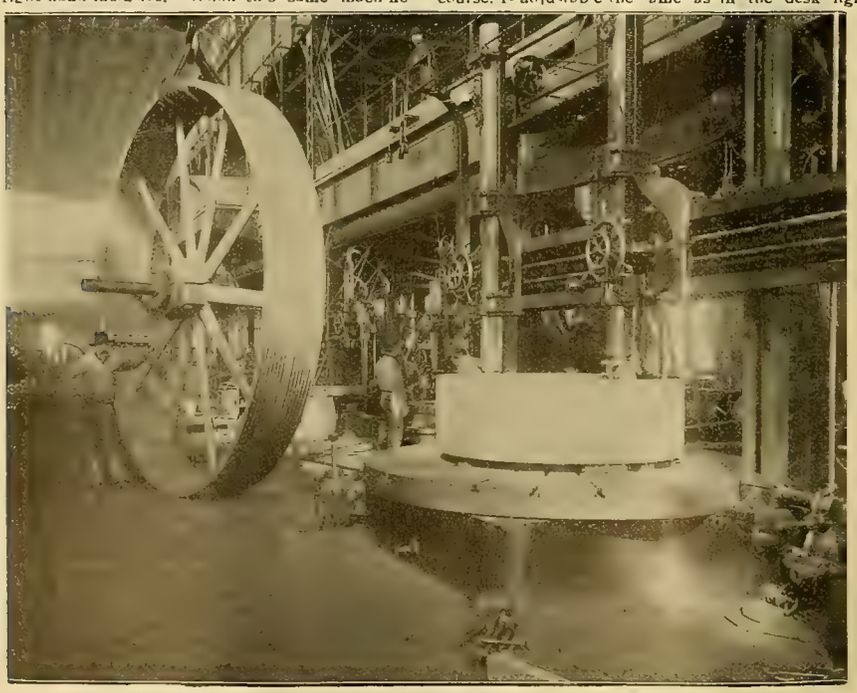


FIG. 2. CHICAGO WORKS OF THE LINK BELT MACHINERY COMPANY.

is supplied with both right and left hand dies, it is then called a No. 3 G power machine, and when made without the power base and gearing for hand power only, it is then called a No. 3 F or 3 G hand. It is intended to stand on the end of a bench, when used by power, but when it is desired to use the machine on outside work, it can be disconnected from its base and carried to the place where the work is to be done, like any other tool, and the work done on the spot, thus saving the delay and expense of carting the pipe to the shop. As a strong boy can with ease thread or cut off six inch pipe on this machine, the helper does this part of the work while the journeyman puts it up, thus making a great saving, which will be appreciated especially on contract work. In this machine the power is derived from a very powerful train of triple spur gearing which gives ample power for even the toughest pipe. The vise for holding the pipe is self-centering and is adjustable. The dies are adjustable to any variation of the fittings and when the thread is cut they draw back out of the way and the pipe taken out without running back.

Portable Desk Lamp.

Since the Kinsman desk light which was designed for roll top desks, was placed on the market, so many inquiries for shades of this style for other purposes have been made that it has been found necessary to make a portable lamp for flat desks, etc. The illustration herewith presented shows a type of this later construction. The shade can be raised and lowered as desired in a similar manner to the ordinary lamp. This eye shade, of course, is adjustable the same as in the desk light, the glass cylinder being revolved by a slight touch for the purpose of modulating the light, two-thirds of the cylinder being ground glass, the other third clear glass. The Kinsman desk lamp is handled by McLeod, Ward & Co., New York. They have appointed the following agents: Central Electric company, Chicago; W. H. Glenny Sons company, Buffalo; Southern Electrical Supply company, St. Louis; Gate City Electric company, Kansas City, and Thomas Day & Co., San Francisco.

Chicago Works of the Link Belt Machinery Company.

While it is a fact broadly known that the Link Belt Machinery company manufactures at its works at Indianapolis, Ind., all of the Ewart detachable link-belting and Dodge chains used in the world, it is also true, that at its works in Chicago the company is fully equipped for manufacturing all kinds of general machinery, as well as its own link-belt specialties. The works are located on the southeast corner of Stewart avenue and Thirty-ninth street, covering 5½ acres of ground, and adjoining the tracks of four trunk line railroads on the west, with yard switches connecting the buildings with the main tracks of the Union Stock Yards & Transit company on the south, which in turn connect with every railroad entering Chicago. The main building, a substantial brick and iron structure is 125 feet wide and 410 feet long, with galleries 40 feet wide extending the entire length, designed to carry heavy weights. This building has been constructed with a view to facilitating the rapid and economic handling of heavy work, and is equipped with a hydraulic crane, on ways forty feet above the main floor, having a capacity of eleven tons, a lateral traverse of forty feet, and available the entire length of the building. A space 370 by 40 feet is devoted to the erection of special machinery, which is subjected to a running test before shipment. In this building are over 125 power tools of the newest and most improved pattern and design; boring and turning mills capable of finishing pulleys, rope sheaves, and engine flywheels of any face or diameter; shafting lathes and straighteners that will turn iron and steel shafting in twenty foot lengths up to sixteen inches in diameter, the sizes being accurately gauged by approved mecometer gauges and guaranteed standard. Here, also, are hydraulic presses for placing couplings in position on shafts in a rapid and improved manner, assuring perfect fit and workmanship, gear cutters for wood and iron gears and pinions, drill

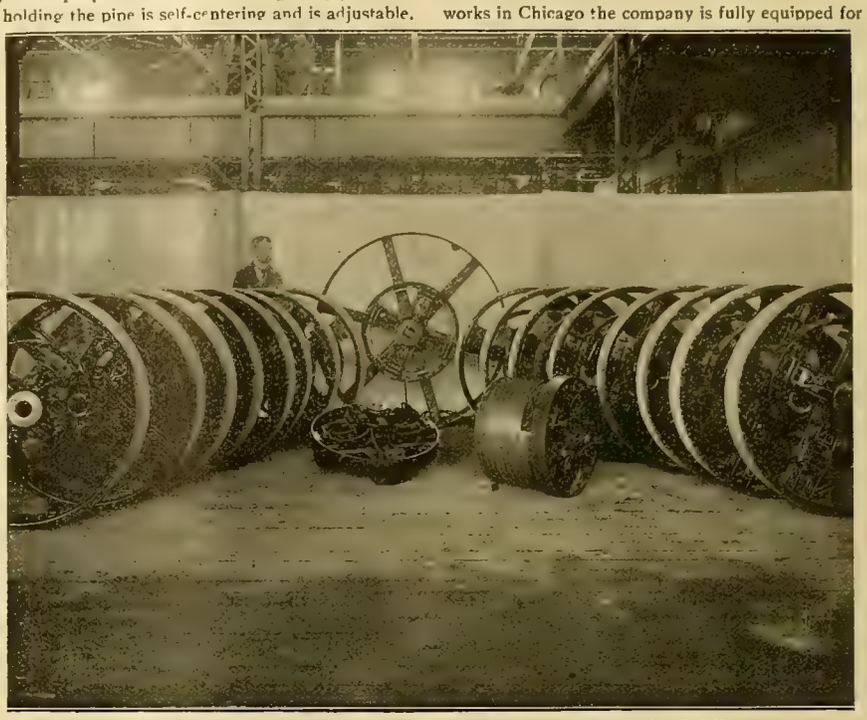
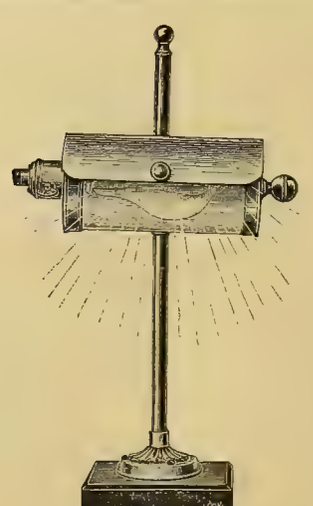


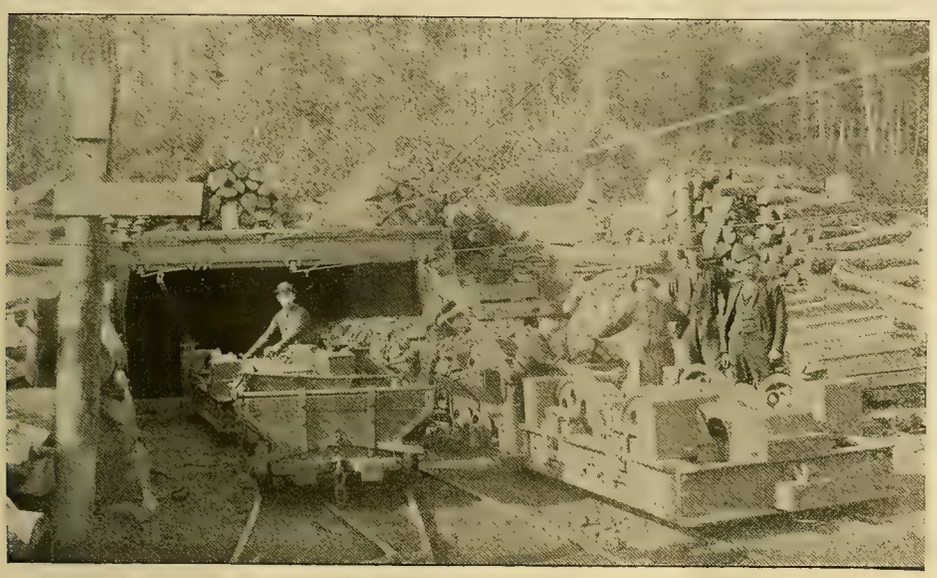
FIG. 1. CHICAGO WORKS OF THE LINK BELT MACHINERY COMPANY.



PORTABLE DESK LAMP.

presses, turret and gap lathes, pulley turning lathes of all sizes, punches and shears for iron work.

Improved woodworking machinery is used in the millwright department and pattern shop, occupying the west gallery, where from thirty to fifty men are constantly employed. Adjoining the machine shop is the blacksmith shop, in which are eight forges and a steam hammer in daily use. Power is provided the machine shop and foundry by a battery of four boilers and an 18 by 42 Corliss engine, contained in the power house, which is 50 by 80 feet. The power is transmitted by a system of manilla ropes and grooved sheaves. Here can be seen a practical



ELECTRICITY IN MINING.

test of the system of which this company was the pioneer in this country, with grooved iron sheaves. The foundry, which is also of brick and iron, 90 by 290 feet, is thoroughly equipped with two Colliau cupolas, having a melting capacity of over fifty tons of pig iron per day, pulley moulding machines, large and improved core ovens, and every facility for prompt and efficient work. This building is equipped with a steam crane of 12 tons capacity, for handling heavy castings, while for lighter work are numerous air hoists distributed throughout the building. Flask sheds communicate directly with the foundry and the pattern storage vault, 40 by 90 feet, in which are stored patterns which represent a cost of over $60,000, is near enough to facilitate the quick use and return of the largest patterns. The foundry and machine shop are con

METROPOLITAN SPECIALTIES.

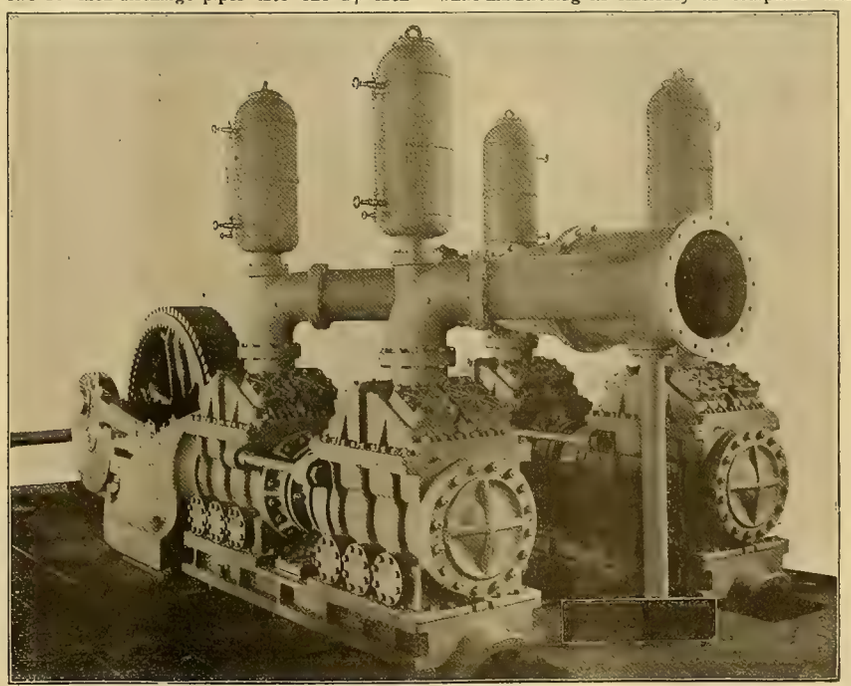
nected by a narrow-gauge track, by which castings requiring machine work are transported. The shipping facilities of the company are noteworthy. Two railroad cars can be loaded inside of the buildings at one time; having the advantage of a noiseless crane service.

As a sample of the work being turned out by the company in Fig. 1 is presented a view of a flywheel rope sheave 14 feet in diameter, having 14 grooves and weighing 12,500 pounds made for the Chicago Beach Hotel. The illustration also shows a large boring mill of which the company has five, upon which sheaves and pulleys from five feet in diameter upward are constantly being worked upon. The view in Fig. 2 is of 16 48-inch five groove rope sheaves with a Ewart guaranteed clutch mechanism cast in each. In the center is a 60-inch clutch-pulley. These sheaves were furnished the Charles Counselmen elevator at South Chicago, Ill., recently, together with all the shafting, pulleys, gearing, etc.

Pumping Engines for Austin, Tex.

In the accompanying illustration is shown a type of the pumping engines furnished by the Stilwell-Bierce & Smith Vaile company of Dayton, O., run by Victor turbines also furnished by the company for Austin, Tex. The pumping engines consist of two duplex double plunger power pumps, each having a capacity of four million gallons per 24 hours delivered into the reservoir under a dynamic head of 165 pounds. The engines are very heavily constructed, the diameter of the water cylinders being 16¼ inches, and the length of stroke being 33 inches. The valve area of both the suction and discharge valve decks is 55 per cent of the area of the plungers. The engine beds are of the Tangye type, very heavy, with cast steel cross heads, adjustable slides, and very heavy connecting rods and stub ends. The shafts are of hammered steel 11½ inches in diameter,

The pumps are driven by mortise spur gears with 18 inch faces. The weight of each pumping engine is about sixty tons. Each water cylinder takes its supply through a 16 inch suction pipe from the forebay with a head of about 10 feet of water on the suction valve and discharges through two 18 inch discharge pipes into one 24 inch main which leads to the reservoir. Each discharge box is provided with a large air chamber, and the whole pumping engine is provided with all the necessary appurtenances and trimmings required for its complete operation.



PUMPING ENGINES FOR AUSTIN, TEX.

Metropolitan Specialties.

One of the last specialties which has passed to the control of the Metropolitan Electric company, Chicago, is the Dayton electric ceiling fan. A good idea of the appearance this fan presents may be gained by reference to the accompanying illustration. It is ornamental in design, absolutely noiseless, mechanically and electrically correct in operation, sub-lubricating, economical in the use of current and positively cannot drip oil. It requires no more space than the ordinary chandelier and is propelled by a small motor just above the fan blades and suspended by a hook securely fastened to the joists in the ceiling. During the winter months it can very easily be taken down and stored, leaving the room perfectly free from defacement. The motors are wound for 110 volts, 220 volts and 250 volts, direct current to be operated in series on a 500 volt street railway circuit or any number of amperes of continuous arc current.

Burnley Cartridge Battery.

The Burnley cartridge battery is a recent invention and discovery in that class of batteries employing sal ammoniac as the exciting agent. The construction of the battery, a

BURNLEY CARTRIDGE BATTERY.

cut of which is herewith presented, is a modified form of Leclanche cell, with an entirely new construction of porous cup.

The porous cup, or cartridge, is made of specially prepared paper board, with sufficient rigidity to withstand the necessary compression. The top of the cartridge is specially parafined to resist the action of creeping salts. By this construction there can be no choking by the deposition of reduced salts within the pores of the cartridge. The reduced salts, as formed, adhere to the extremely fine shreds always present on paper, and having a flimsy support soon drop by their increased weight to the bottom of the jar. The internal arrangement of the depolarizing compound of carbon and manganese surrounding the negative electrode is such as to utilize all the oxygen present in the manganese, and thus a smaller bulk of this material can be used, thereby reducing the size of the cell while maintaining its efficiency as compared with other forms of cells. This cell is being manufactured and sold by the Miamisburg Electric company, Miamisburg, O.

Electricity in Mining.

Concrete examples of the adoption of electricity to the exclusion of older methods are generally more convincing in their import to the public mind than mere heresay or description. The accompanying illustration shows a striking example of the supersession of older haulage methods by the electric mine locomotive in a coal mine in Pennsylvania, and emphasizes the vast advantage which its use confers. The installation is in the Bear Run mine of the

Blossburg Coal company, near Landrus, Tioga county. The locomotives, of which there are two, are of the "two motor mining" type, each of 30 horse power, manufactured by the General Electric company. They are propelled by two waterproof 30 horse power motors, one being geared to each axle. Current is brought to the motors by a specially designed trolley arm, on which the trolley wheel is swivel'ed to permit of its adjustment to the various irregularities of the wire line. The trolley arm can be set in sockets on either side of the locomotive, which may thus be run into headings on either side of the main haulageway, which is lighted by incandescent lamps placed at the entrance to each cross-head 100 yards apart. The dimensions of the machines are: Horse power, 30; speed, six miles per hour; draw bar pull, 1,500 pounds; gauge, 36 inches; wheel base, 30 inches; diameter of wheels, 28 inches; width over all, 48 inches; length over all, 9 feet 6 inches; height above rail, 31 inches; weight, 7,500 pounds. The current is furnished by a General Electric D 62, 75 horse power generator driven by a Harrisburg Ideal 80 horse power engine.

The maximum load which these locomotives have been called upon to handle is thirty-two loaded mine wagons, each weighing 3,200 pounds, and the way has at one part a three per cent. grade. The daily haul of these locomotives is about 650 tons. The entire plant has been pronounced eminently satisfactory, the locomotives having shown capabilities beyond the specification or the General Electric company's guarantee. Their presence in the mine has done away with the slow going mule and induced great economy. The small height of the machines above the rail level allows them to go into places impossible to any mule, and their ease of control and operation is such as to render them much superior.

Wurts Non-arcing Railway Lightning Arrester.

The results upon light and power circuits from lightning discharges are well known to electrical engineers as one of the most perplexing problems in actual practice,

WURTS NON ARCING RAILWAY LIGHTNING ARRESTER.

and a great deal of study has in the past been given the subject with but indifferent results. The Westinghouse Electric & Manufacturing company has among its different types of apparatus a lightning arrester which solves the difficulties heretofore experienced. The discovery of non-arcing metal more than two years ago indicated the possibility of a lightning arrester which would meet all requirements and at once pave the way towards the successful culmination of the efforts which have been made in this direction. The fundamental principles of the Wurts non-arcing railway lightning arrester are based upon the facts that a static discharge will leap over a non-conducting surface, such as glass, wood, marble, etc., more easily than through an equal air space, and that a dynamo arc in order to be maintained must be fed by the fumes or vapors of its electrodes conversely, therefore, that in order to avoid the formation of a dynamo arc between electrodes, means must be taken to prevent the formation of these conducting fumes. In the non-arcing railway lightning arrester the discharge is caused to pass between two brass electrodes separated by half an inch and over narrow grooves burned into a block of lignum vitae. The discharge takes place not by conduction, but by disruption, leaping between the electrodes and over the charred surface, the latter acting simply as an electrical crack through the air and thus greatly assisting the passage of the electrical discharge; neither does this charred surface leak dynamo current, for the ohmic resistance between the electrodes is more that 50,000 ohms. If a solid lignum vitae block be firmly screwed down over the charred grooves and metal electrodes it will be impossible for conducting vapors to form and the device is at once a non-arcing lightning arrester. This arrester for station use is shown in the accompanying illustration.

This non arcing railway lightning arrester is eminently suited for the protection of direct current circuits up to 1,000 volts. On 1,000 volt alternating current circuits from smooth body armatures it also operates satisfactorily, but on similar circuits from toothed body armatures the arresters break down after a few discharges and a short circuit is established. However, it is probable that two or three of these arresters might be used to good advantage in series on circuits of high potential.

General Electric Company at the Midwinter Fair.

The representation made by the General Electric company at the Midwinter Fair, which is, of course, considerably less important than that made by it at Chicago, from the point of view of mere quantity, is still very important. The display of its purely mechanical exhibit is made in the palace of mechanical arts, and the space allotted is occupied by many of the later types of its machinery, apparatus and instruments, the major portion being devoted to a fine exhibit of electrical mining and power transmission apparatus. The chief use of electricity on the Pacific Coast is to transmit power to the cities and towns for railway and lighting work, and to the mining centers for the operation of the different electrical mining apparatus, such as drills, crushers, pumps, etc.

Among other apparatus, the General Electric company exhibits the following: A three-phase rotary four pole transformer similar in design to those now in use at Redlands, Cal., and to those which will be used at Niagara Falls. It resembles a continuous current transformer in which the primary and secondary are wound on the same armature. It is wound for a potential of 200 volts at the receiving or moter brushes, while the potential of the three-phase current is 500 volts.

The most important feature is a complete three-phase power transmission plant. The generator is of 35 kilowatt capacity, and is driven by means of belting by a 35 kilowatt bipolar motor. The current of the generator is led to a switchboard containing the usual set of instruments, such as Thomson-Houston indicators, recording wattmeters, switches and fuses, and the line is carried on oil insulators, after having been transformed in the step-up transformers from a potential of 300 to one of 6,000 volts, to the switchboard of the receiving station. Step-down transformers are there employed, which reduce the voltage to 300, under which pressure the current is delivered to a 10 horse power three phase motor, which is belted to what is generally termed a "drill" generator, a dynamo having rotary brushes, used to operate percussion drills. The drill exhibited is of the General Electric percussion drill type. Connection is made by means of a cable armored for its better protection in mine work.

A 10 horse power mining locomotive, 24-inch gauge, and equipped with two 500 volt iron-clad motors, also forms part of the exhibit. This locomotive is well adapted for mine work, as it is built very low for entrance into low gangways. The seat for the motorman is in front, and all operations, such as starting, stopping, reversing, applying sand to the rails, etc., can be quickly done, the handles for the levers for these operations being all within easy reach. Two 16 candle power lamps in a reflector form the headlight. Portable mining outfits are also shown, one consisting of a special motors running a swivelled diamond drill by means of bevel gears, which can be thrown out of mesh so that a friction clutch allowing of the connection of the motor to a hoist can be thrown in, the motor, serving for the two different operations. On the same truck with this apparatus is also mounted a three kilowatt Edison motor, connected to a triplex Gould pump.

There are also set up and in operation a rotary pump, driven by means of a rigid coupling from a three kilowatt Edison motor mounted on the same base, the pump delivering about 300 gallons a minute; another portable pump outfit, consisting of a three kilowatt Thomson-Houston motor connected by two intermediate gears (the pinions being of rawhide) to a Gould triplex pump, delivering about 100 gallons a minute, the whole being mounted on a truck, and a 10 horse power sinking pump for deep mine work, perfectly water-tight. All these pumps are working with very little noise and vibration. A board filled, in regular style, with instruments, such as watt meters, indicators, fuse blocks, railway supplies, etc., a few fan motors, which attempt to make things lively by means of colored ribbons attached to their frames and floating in the air currents produced; a 24 inch projector, marine type; four large ball clusters on poles, each containing forty 16 candle power lamps and two cubes of fifty-four 16 candle power, each complete the exhibit so far as the exposition space proper for the company is concerned.

A 200 kilowatt railway generator furnishes current for cornice lighting, the lamps being connected five in series, as well as for the motor of the tower elevators. This is driven by a double piston valve engine of the Joshua Hendy Machine Works of San Francisco, the cylinders, 14 by 18 inches, being belt connected. This dynamo is on the opposite side of machinery hall, near the boiler house, where are also eight Thomson-Houston arc light machines, each of 50 lights. These are driven, four each, from two countershafts which in turn are belted one to a Buckeye automatic cut-off slide valve engine of 200 horse power capacity at 140 revolutions; the cylinders being 14 by 24 inches, the other one to a 150 horse power Russell engine of 190 revolutions, with a cylinder 13 by 20 inches and fitted with the Russell automatic cut-off slide valve and fly-wheel governor. The annex shelters a 150 kilowatt Edison dynamo, supplying current for the electric fountain and the searchlight on top of the electric tower. This machine is belted to a 250 horse power tandem Thompson slide valve engine, manufactured by the Golden State & Miners Iron Works of San Francisco. Near by is a 6,000 light alternator driven through the intervening medium of a countershaft from a 500 horse power Corliss engine of 80 revolutions per minute.

The searchlight on top of the electric tower is that which was exhibited at Chicago. It is a 60 inch projector with a Mangin spherical mirror, and is one of the largest in the world. The fountain is one of those which played at the World's Fair and has been fully described in this journal. In its new position it is much better situated for display and is not subjected to the violent competition of surrounding white buildings and blaze of light.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 9.—To a disinterested spectator who has watched the development of the rapid transit agitation in this city, the existing condition of affairs must be amusing. A short time ago the people of New York watched the deliberations and lack of action of a rapid transit commission and in a blind sort of a way placed considerable confidence in the ability of that body to provide some means for them to reach their residences quickly and comfortably. For years the present was made endurable by prospects of the future and it would be a happy conclusion to chronicle that the patience of the people was rewarded and a means of rapid transit devised. But at length even toleration became a crime and it was decided by the representative business men of the city, as found in the Chamber of Commerce, to legislate the present commission out of office, create a new one and instruct it as to its course. The people beheld action and decision and it seemed as though a happy chord of public sentiment had been struck. Petitions in favor of such a movement were crowded with names and a bill known as the Chamber of Commerce rapid transit bill was sped to the Legislature of the state of New York with metaphorically, the favoring shouts of the people. The original rapid transit commissioners had been temporarily forgotten, and although it was announced that they had "met and adjourned without arriving at any decision," the statement had become such an accepted matter of fact that no one paid any attention to it. The situation was an interesting one, and to such a stage of enthusiasm had the promoters of the Chamber of Commerce rapid transit bill been raised that the fact of a bill providing for the accomplishment of the same purpose, introduced into the assembly some time previously was in existence seemed to have been forgotten. Bushe's new elevated line scheme was lost sight of, not a thought was given to the Manhattan Elevated Railroad company, and it was this entire oblivion to everything else that made the announcement that the rapid transit bill known as the Lenow-Butts bill had passed the assembly the more startling. The purport of this bill, which is sanctioned as coming from the trade unions, has been noted in the columns of this journal, and it is doubtless at this stage a very unfortunate bill. There is every reason to believe that the Legislature narrowly escaped passing, while asleep, a bill giving the present elevated railway company of New York, a monopoly in New York City of the elevated railway business and also granting to Tammany Hall authority to build and operate an under-

ground railway costing $50,000,000. The bill was introduced in the assembly by Mr. Butts, and in the Senate by Senator Lexow. The measure passed through the Assembly late last Tuesday night without the inspection apparently of any one but Tammany Hall assembly men. It is on the order of third reading in the senate. An analysis of it made by ex-Mayor Abram S. Hewitt of New York, before the senate and the assembly railway Committees Thursday showed clearly that it must have been drawn up in the interest of the Manhattan Elevated Railway company, since its chief provision was one giving that company exclusive possession of the right to build elevated railways on Manhattan Island, and authorizing that company to extend its lines without making any compensation to the city. Further, the bill openly conferred upon Tammany Hall authority to build and operate an underground railway.

The bill attributed to the laboring men is not the popular measure and now that the true significance of its terms have been exposed by Mr. Hewitt its ultimate fate is undoubted. The Chamber of Commerce bill is, with a few minor changes, unquestionably the most sensible step toward rapid transit. It has the approval of those most interested and is the product of the deepest thought of the most able men in the city. It is not a political measure and its provisions are for the most part founded upon sound principles. All the evidence obtainable at this time indicates that a majority of the intelligent citizens of New York are heartily in favor of the rapid-transit plan which the bill is designed to carry out. The main features and the essential purpose of that measure are certainly approved by those who have most impartially and carefully considered the existing conditions and requirements of the metropolis. Some modifications of the bill which the Legislature has now begun to consider seriously may be desirable. It seems hardly wise to call upon Brooklyn for a member of the proposed commission, no matter how well qualified that gentleman may be for the position. This is the most important period of the rapid-transit agitation and the outcome of legislative action is so important that extraordinary interest will be manifested in the proceedings at Albany.

The certificate of incorporation of the Mercantile Electric company was filed April 6th, in the office of the county clerk. Its purpose is to construct and maintain lines of telegraph and telephone, and its line is to run from 120 Broadway, connecting with the United States subtreasury and various other buildings and through such streets in the city as the needs of the business may require.

Articles of incorporation of the Erie Canal Traction company were filed with the Secretary of State April 4th. The object for which the company was formed is to produce, purchase, sell, and distribute power in the form of electricity or otherwise, for the propulsion or traction of boats and vessels upon the Erie canal; to lay, build, and erect all machinery, storage batteries, conductors, and other apparatus of every kind incidental to the business, and to furnish, sell, and distribute along the line of the canal and in the cities and villages adjacent thereto power for any purpose incidental to the business. The capital stock is placed at $100,000, divided into one-hundred-dollar shares, with power to increase to $4,000,000. The principal business office will be in New York city, and the duration of the company is fixed at fifty years. The directors for the first year are: George G. Haven and Richard S. Hayes, of New York, representing the Metropolitan Traction company of New York city; Thomas C. Platt, of Owego; Adrian Iselin, Jr., of New York; Baron Louis A. Von Hoffman, of New York city, who is the head of the foreign banking house of Von Hoffman & Co.; Alfred S. Heidelbach, head of the foreign banking house in New York city of Heldelbach & Ickelheimer, and Charlton T. Lewis, of New York city, counsel for the Mutual Life Insurance company and secretary and treasurer of the Cataract General Electric company. The incorporators of the company are: Frank W. Hawley, Vice-president of the Cataract General Electric company, and the gentlemen named as directors. The subscribers to the capital stock of the company are: George G. Haven, Frank W. Hewley, Adrian Iselin, Jr., Charlton T. Lewis and Richard S. Hayes, each of whom subscribes for ten shares. Charlton T. Lewis, attorney for the new company, and one of its incorporators, has made the statement that beyond the fact that the company would be auxiliary to the Cataract Electric company, and had been formed to place electric power along the Erie canal, no plans had been formed. Experiments were in progress with various modes of electric traction, but they had developed nothing final in this respect. Touching the report that the Metropolitan Traction company had figured on furnishing power along the canal, George G. Haven, Jr., said there had been no movement in that direction. The report had nothing behind it except the connection of some of the incorporators of the canal company with the Metropolitan Traction company.

The Brooklyn Board of Alderman approved the report of the lamps and gas committee last week, giving the contracts for furnishing the lighting of the streets to the Edison Citizens' and Municipal companies. By the terms of the resolution adopted the Edison company will soon be in a position to control a major part of the street lighting. Hitherto this company has been out in the cold, so far as city patronage was concerned, and the two other companies which are controlled by democratic politicians, had virtually a monopoly of the business. The lamps and gas committee also reported in favor of giving a franchise to the State Electric Light & Power company, which had been vainly seeking this privilege from the two preceding boards. Alderman Cohn said that President Noah L. Cocheu had been credited with making statements seriously reflecting on the integrity and good faith of some members of the board, and he suggested that before the franchise was granted an investigation of the charges should be made. After some discussion the president of the board was directed to appoint a committee of seven to make an investigation.

At the meeting of the board of electrical control, held last week in the mayor's office, some facts in connection with the removal of the overhead wires were reported, which show that the commissioners are making rapid progress in the direction of clearing the city of them. The report of Dr. Schuyler S. Wheeler shows that Broadway has been cleared from Twenty-third street to the Battery of housetop wires. Seventy-four miles of wire were removed by this wholesale cleaning out, and in addition to this various wires in other parts of the city were cut down, so that, all told, about ninety miles of electrical wires of all kinds and descriptions were taken down during the months of February and March. All wire thus removed and confiscated is turned over to the Department of Public Works and utilized saving the city a large amount of money. Governor Flower has signed a bill to extend the term of the board of electrical control for three years.

Prof. George W. Plympton, subway commissioner, sent to Mayor Schieren last week, the following self-explanatory communication:

"In accordance with your request given verbally a few days since, I submit an approximate estimate of the cost of converting the present aerial system of telegraph lines belonging to the city to an underground system. The estimated cost, based on the use of conduits of creosoted timber of sufficient extent to include the whole system, is about $400,000. If the plan of suspending the lines to the elevated road is continued, so far as the routes are identical, the total cost of replacing the present pole system would be something less than $300,000. In a communication to this board from the former commissioner of the fire department in November last, the cost of a complete system of iron conduits with cables and assessories was estimated at $1,200,000." W. F. O.

PERSONAL.

E. Kuhlman, of the Hornberger Electric Manufacturing company, Elkhart, Ind., was in Chicago, last week.

A. A. Thresher, of the Shawhan-Thresher Electric company, Dayton, O., passed through Chicago last week.

William F. Breidenbach, general agent of the F. P. Little Electrical Construction & Supply company, Buffalo, N. Y., spent a few days in Chicago last week.

Walter C. McKinlock, secretary of the Metropolitan Electric company, Chicago, has just returned from a western business trip which proved very successful for the interests of the company.

Frank McMaster traveling representative of the Electric Appliance company has been confined to the house for the last month with an attack of peritonitis, but is now out again and ready for business.

E. W. Goldschmidt, who has been representing the Western Electric company at the California Midwinter International exposition, is in Chicago. Mr. Goldschmidt, while at the fair, was also looking after the interests of his company upon the Pacific coast, and secured a number of large and flattering contracts.

S. F. B Morse of Cushing & Morse, Chicago, is one of the heirs to the estate of Mrs. Cornelia Frances Coster of New York who recently died leaving a large estate, one million of which was to be expended on a tomb. Mr. Morse has been called to New York to confer with the other heirs regarding the advisability of contesting that clause in the will.

ELECTRIC LIGHTING.

The town of Union, Mo., ten miles from Washington in the same state, has voted to obtain a supply of current from the Washington electric light plant for lighting the town. It is expected that the arrangement will be perfected in thirty days.

The village board of Cassopolis, Mich., has granted an electric light franchise to the Cassopolis Light & Power company for a period of 25 years.

Electricity has superseded gas to such a large extent at Madrid, Spain, that the shares of the gas company, which were quoted at 540fr. before a supply of electric energy was available, have fallen to 175fr. The company is now making great efforts to introduce gas heating and cooking apparatus, and has opened show-rooms with an abundant supply of the best apparatus for all applications.

ELECTRIC RAILWAYS.

The plan for connecting Skaneateles, N. Y., with Auburn and Port Byron, and possibly Syracuse by an electric road is again being considered. The idea is not a new one but the advantages to be derived from such a road are so apparant that much interest is being taken in the present agitation. If the three towns should combine and offer a reasonably large bonus it is more than probable that the remainder of the money would be raised in New York and the road constructed.

The Richmond Street Railway company, already in the hands of a receiver, is in imminent danger of going under. Some time ago the Union Trust company of St. Louis foreclosed on its mortgage, amounting to $212,000, and the court has now admitted the General Electric company on a claim of $32,000 and the Cambria Iron company of Johnstown, Pa., on a claim of $5 000 as parties in the suit. Besides these the city of Richmond will endeavor to collect an indebtedness of $15,000.

The Camden, Pa., Gloucester & Woodbury Electric railroad company has awarded the contract for the extension of its line from the terminus at North Woodbury through Woodbury to the New York Consolidated company, and work will be commenced in a few days. If the Board of Freeholders grant the company permission to cross the bridge over Woodbury creek the road will be in operation by the first of June. At a meeting of the Greenwich township committee, on Thursday, an ordinance was passed giving the company the privilege of entering Paulsboro. The road will run over the main street and connect with Lincoln and Germania Parks. The question of crossing the tracks of the West Jersey railroad at grade on Cooper street, Woodbury, has been practically settled by the state board of commissioners of electrical subways, which body gives the company the privilege of all the streets named, in the ordinance, except Cooper street.

MISCELLANEOUS.

The Taftville Cotton Mills, Norwich, Conn., will be run by electricity.

The last issue of the *Technic*, the annual of the engineering society of the University of Michigan, a well printed and tastefully arranged book, contains some very interesting papers. The electrical contributions comprise an exhaustive article upon the "Electric Subway at the Columbian Exposition," with a number of illustrations, "Safety Fuses," a carefully prepared article and "An Efficiency Test" by Fred H. Loveridge.

TRADE NEWS.

The Strowger Automatic Telephone exchange of Chicago has ordered from the Western Telephone Construction company one hundred of its standard magneto telephones to replace the battery telephones in the automatic exchange of La Porte, Ind.

C. E. Bonnell, Craigin, Ill., the manufacturer of Bonnell's Nubian iron enamel, "the best and blackest black on earth" has issued a slip calendar by means of which the virtues and merits of the Nubian enamel are kept constantly before the eye. The calendar is handy as a memorandum too, and doutless its extensive distribution will add materially to the sales of Mr. Bonnell's product.

The Lodge & Shipley Machine Tool company, Cincinnati, O., has placed the results of its experience and knowledge of machine tools for the rapid production of lathe work into a book. It comprises illustrations of the different types of machines the company manufactures with an extended description of their construction and operation. In the back of the book is a number of testimonial letters which the company has received from manufacturing concerns using its machinery.

"Insulation" is the terse title of a book just issued by H. W. Johns Manufacturing company, 87 Maiden Lane, New York. It treats of the well-known insulator devices of this company and comprises illustrations and descriptions of each specialty, such as the Hawkes patent tree insulator, Grant steam insulators, etc. Vulcabeston is given a considerable degree of attention and space, and many of its applications explained. Moulded mica is another product for which an examination and trial is asked. Illustrations of a full line of insulating goods are presented and the book is deserving of a reading.

The Sunbeam Lamp Manufacturing company, Chicago, is distributing several circulars containing some interesting figures upon the life and efficiency of incandescent lamps. The Sunbeam lamp, the company states, is not manufactured as a cheap lamp, but is made of the highest grade of materials with the idea of obtaining economy by the least possible consumption of current and the longest life. In one of the circulars some suggestive facts in reference to incandescent lamps are given which should be interest-

ing reading matter to intending buyers. The sales agent of the company in Chicago is the Wallace Electric company.

The last catalogue published by the Medart Patent Pulley company, St. Louis, Mo., is the fifteenth, in its annual series. Several additions have been made to the output of the company to supply a growing demand for the latest and most improved patterns in its line of manufacture. A full line of ring oiling ball and socket bearings in pillow blocks, double brace drop hangers and adjustable post hangers has been added as well, as many other specialties. The book is a very complete one and is well illustrated.

The St. Louis Iron & Machine Works, St. Louis, Mo., builders of the cross compound, tandem compound, triple expansion St. Louis Corliss engine, has issued its descriptive book for 1894, a work which illustrates and explains in detail the construction and operation of the engine. The shops of the works are modern, large and well arranged for the convenience and rapid handling of the largest and heaviest, as well as the smallest work. They are fitted with modern, accurate, heavy tools, and the men employed are all high class workmen.

The United States Improvement company, manufacturer of complete central station equipments, D exel building, Philadelphia, makes the announcement that it has operated its new type of alternator under practical conditions for a sufficient length of time to demonstrate that it is a step in advance in alternating work, and that it feels that it has reached that point where it is determined to push the sale of the apparatus for all it is worth. To that end the company is anxious to attract the attention of responsible electrical concerns in most of the large cities in the country which are actively engaged in the sale of electric lighting machinery. It is the company's intention to arrange with the more prominent of these for the sale of its apparatus.

J. B. Walker, assignee of the Ansonia Electric company, Chicago, has issued a circular letter to the creditors of the company asking their views upon the question of whether the business shall be further carried on, or immediately closed out and the remaining assets sold to the highest bidder. The stock of goods on hand at the present time at inventoried prices amounts to about $25,000. Every facility is offered for the inspection of the stock, and many desirable electrical supplies are obtainable under circumstances favorable to the purchaser. In fact, an opportunity is here presented which should be given consideration by electrical supply men. If in the opinion of the creditors the business should be discontinued immediately, the assets will be disposed of at once to the highest bidder for cash.

E. J. Spencer, who severed his connection with the General Electric company some time ago, has opened an office in the Security building, St. Louis, as a consulting and contracting electrical and mechanical engineer. Mr. Spencer's experience of nearly nine years in the corps of engineers of the United States army, of three years of special work at the factories of the Thomson-Houston Electric company, Lynn, Mass., and then latterly of more than a year in charge of the installation, maintenance and removal of exhibit and contract material of the General Electric company at the World's Columbian exposition, well equips him for his new work. In extending to Mr. Spencer patronage, the benefits of a wide experience and a large acquaintance with the work of the leading engineers of the day will be secured.

BUSINESS.

H. B. Coho & Co., New York, report that they intend in addition to handling the Mather company's apparatus, to make a specialty of small plants for country residences. There seems to be a great demand for plants including gas engines, storage batteries and dynamos and doubtless Messrs. Coho & Co. will have considerable success in this line.

The Western Electric company, Chicago, has secured through its representative at the California Midwinter International exposition, E. W. Goldschmidt, the contract for the electrical equipment of the new Bohemian Club building, San Francisco, including the electric light wiring, annunciator bells, etc. The contract is an important one, the club being one of the most exclusive organizations in the city.

W. H. Fleming has severed his connection with the International Trading & Electric company. The Manhattan General Construction company of 50 Broadway, New York, and 753 Monadnock building, Chicago, has made arrangements with him to act as selling agent for his patent woven wire gauge dynamo brush. All orders and inquiries relating to prices and sizes of brushes in stock ready for immediate delivery should therefore be addressed to the Manhattan Construction company, New York.

Cushing & Morse, agents for Kerite wire and cables at 225 Dearborn street, Chicago, are not necessarily superstitious, but that they believe in signs is evidenced by the handsome new 30 foot sign which now stretches across their building fronting on Dearborn street opposite the postoffice. This firm reports that the outlook for a good spring trade is excellent, as it is receiving many orders for Kerite wire and cables, which it is pushing in the vigorous and successful manner that has been so noticeable since it assumed the agency.

Having accepted the presidency of the Mechanical Boiler Cleaner company, working under the Stewart patent, the address of Thomas L. Scovill is 32 Park Place, N. Y., room 55. Mr. Scovill was formerly connected with Holmes, Booth & Haydens. His seven years' experience as their New York agent makes Mr. Scovill familiar with the metal and copper market, including wire for all electrical uses, and with iron and steel wire for telegraph and telephone work, and warrants him in offering his services as manufacturers' agent for the sale or purchase of such supplies.

Warren Webster & Co., Camden, N. J., manufacturers of vacuum feed water heaters and purifiers and oil and steam separators, report that the number of orders they received for these specialties during the month of March, was very satisfactory and showed a marked improvement over immediate preceeding months. They say that the reason that their specialities sell during hard times is on account of the fact that they are fuel saving devices. Rapid progress is being made upon the new extension of their wrought iron department, connected with the new works, which were built last year.

The Columbia Electric company, Worcester, Mass., is the largest electrical house in central Massachusetts. It manufactures the Columbia dynamo, electric light and railway supplies and makes a specialty of isolated installations. The supply department of this concern represents a large and varied assortment of electric light and railway supplies. The company has constantly on hand many electrical novelties in full operation. The company has installed many plants complete, all of which are giving excellent satisfaction. Manufacturing its own dynamos enables it to submit prices which invariably command business against the closest competition.

Attention has been called to the reduction in the price of the "New Beacon" incandescent lamp of 16 candle power, manufactured by the Beacon Vacuum Pump & Electrical company, Boston, Mass., in barrel lots to 25 cents. When the lamp was first placed upon the market, although its merits were pronounced, it was found advisable to make some minor changes which tended to give it even greater efficiency. The company now asserts that it has a lamp which will and does give perfect satisfaction. The popularity of the Beacon lamp is rapidly spreading and no better sign of this can be had than the large orders which are being taken. One for 25,000 lamps was reported last week.

The White-Crosby company which is to succeed J. G. White & Co., electrical engineers and contractors, New York, on May 1st, will have its headquarters in the Equitable building, Baltimore. O. T. Crosby will act as president, J. G. White as vice-president and general manager and G. H. Walbridge, secretary and treasurer. The New York office will be at Mr. White's present offices, No. 29 Broadway, and will be under the management of A. G. Greenburg, now in charge of the insulated wire department of the Washburn & Moen Manufacturing company. J. F. Esterbrook will have charge of the Chicago office, located at 527 Rookery. The principal work of the new company will consist of street railway work and long distance transmission of power; and, as opportunity offers, general contracting in other lines will be taken up.

Every device which has for its object the more rapid and reliable controlling of a car should receive careful consideration. Among some of the latest improvements in this line may be noted a new electric coupled clutch car brake manufactured by the Safety Clutch Brake company, 725 Sansom street, Philadelphia. The power of the brake is limited only by the length of the lever. The ratchet feature, strengthened by the strong coupled clutch bearings, gives the operator control of the car at all times; the dog on the platform holding the teeth of the sprocket wheel at every turn. It is instantaneous in action, and an ordinary street car can be readily stopped within a few feet. The friction is so slight at every contact point, that its life is remarkably long. Inspectors can examine its every part without inconvenience or a moments delay, by merely unscrewing the casing. Sample brakes are furnished by the company.

The Metropolitan Electric company, Chicago, is steadily increasing its number of exclusive specialties. The latest article which the company has determined to place in competition for popular favor is the I. X. L. high grade, weatherproof wire. The company will carry a complete stock of the wire and act as the general western agent for it. Since moving into its new home on Fifth avenue the Metropolitan Electric company has been adding to its list of exclusive agencies with almost surprising regularity. These specialties now include the P. & B. products, N. I. R. rubber covered wire, I. X. L. weatherproof wire, the Metropolitan incandescent lamp, Paiste's Xntric switches, sockets, etc., the Gibbs trolley, Dayton ceiling fan motors, Metropolitan dry battery, Mac tape, the Knox electric railway circuit breaker and the Paragon speed indicator. The store is now well supplied with the stock which the company intends to carry and comprises the innumerable articles of which the electrical supply business consists.

ELECTRICAL PATENTS.

Issued April 3, 1894.

517,427. Process of Manufacturing Active Material for Secondary Electric Batteries. Wilhelm A. Boese, Berlin, Germany.

The active material is manufactured by mixing a metallic oxide with a sulphonic acid of of anthracene and simultaneously removing electrolytically soluble compounds.

517,432. Incandescent Lamp. Augustus C. Carey, Lake Pleasant, Mass.

517,450. Electric Burglar Alarm. John Frame and Robert B. Morden, Cooper, Ia.

517,452. Insulating Compound. Adolf Gentzsch, Vienna, Austria-Hungary.

The compound consists of an extract from fossil resins as ozokerite, asphalt and amber, from which the gas vapors and oils have been removed.

517,455. Secondary Cell or Battery. George B. Henry, Hartford, Conn.

The electrolyte is composed of a spongy mass of flaxseed mixed with dilute sulphuric acid.

517,480. Electric Synchronizer for Clocks. Henry S. Prentiss, Elizabeth, N. J.

The several secondary clocks are regulated to run slightly fast, and are provided each with a detent to engage with a moving member of the train to arrest the motion of the same, an electro-magnet being provided for throwing the detent into engagement with the moving member, the detent being held out of engagement with the moving member until the hour as indicated by the secondary clock. A circuit-closer is provided at the master clock to close the circuit through the electro-magnets of the secondary clocks at a predetermined period before the hour as indicated by the tube master clock, and to break it at that hour.

517,498. Electric Train Lighting and Braking System. George W. Swartz, Florence, Ala.

517,502. Circuit Maker. Joseph Weaver, Canandaigua, N. Y.

517,520. Miner's Safety Lamp. Jesse Graham and Harry Chapman, Morley, Eng.

517,531. Induction Electric Railway. Charles E. Roehl, St. Joseph, Mo.

The roadbed is provided with a magnetically continuous iron core separate from but extending parallel to the tracks, and with a series of primary coils located upon the core. The moving vehicle carries a secondary core and coil in inductive relation to the primary core.

517,547. Burglar Alarm Spring. Minthorne T. Gordon, Stapleton, N. Y.

517,549. Conduit Electric Railway. Willie C. Keithly, San Francisco, Cal.

517,564. Microphone. Wilhelm Deckert, Vienna, Austria-Hungary.

517,565. Motor Car Truck. William A. Dutton and Jacob F. Pfetch, Cleveland, O.

517,569. Adjustable Desk Bracket for Electric Lamps. Stephen G. Garlock and Bennie W. Marshall, St. Louis, Mo.

517,582. Electric Switch. Robb Mackie, New York, N. Y.

517,591. Insulating Tube. Miner Robinson, Newton, Mass.

The tube is to be driven into a hole provided in a wall, through which it is desired to pass the conductors, and is made of insulating material as rubber, and provided upon the outside with three or more longitudinal ridges, which engage the walls of the hole and maintain the tube concentric with the hole and with an air space about it.

517,621. Insulator. Louis McCarthy, Boston, Mass.

517,634. Pin for Insulators. George H. Winslow, Pittsburg, Pa.

517,638. Car Fender. Carl P. Anderson, Boston, Mass.

517,664. Electrical Switch. Ernst Ruebel, St. Louis, Mo.

517,668. Electric Motor, William J. Still, Toronto, Can.

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517,692. Conduit Electric Railway. Herbert A. Goreham, Decatur, Ill.

517,714. Governor for Electric Motors. John F. Winter, Baltimore, Md.

517,734. Feeding Mechanism for Magnetic Separators. Gurdon Conkling, Glens Falls, N. Y.

517,743. Electrically Operated Railway Switch. William S. Gavey, Brooklyn, N. Y.

517,749. Underground Conduit Railway. Wilton F. Jenkins, Richmond, Va.

517,762. Telephone. Stewart D. McKelvey, Canton, O.

517,763. Magneto Telephone. Stewart D. McKelvey, Canton, O.

517,764. Magneto Telephone. Stewart D. McKelvey Canton, O.

The telephone comprises a transmitting diaphragm and an amplifying device, a rigid arm being pivotally connected to the amplifying device at one end, and having at its other end divergent points, which are attached to the transmitting diaphragm in or between different nodal circles.

517,770. Rheostat. Alton J. Shaw, Muskegon, Mich.

517,778. Electric Stop Motion Drawing Frame. Edmund Tweedale, Samuel Tweedale and Joseph Smalley, Castleton, Eng.

517,804. Conduit Electric Railway. Wilton F. Jenkins, Richmond, Va.

517,812. System for Controlling Electric Lights. William F. Bradner, Denver, Colo.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents expiring during the week ending April 3, 1894:

189,116 Dynamo-electric Machines. D. F. J. Lontin, Paris, France.

189,184. Automatic Telegraphy. James W. Brown, Port Huron, Mich.

189,262. Insulated Wire. H. Redding, Boston, Mass.

189,272. Dial Telegraphs. R. J. Sheehy, Boston, Mass.

189,276. Multiple Telegraphs. G. Smith, Astoria, N. Y.

189,286. Lightning Rods. L. D. Vermilya, Dayton, O.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, APRIL 21, 1894. No. 16

Electric Transmission of Power in Chicago.

The great advantages to be gained by the application of electric motors to line shafting and large machines in factories are receiving special attention at the present time from manufacturers. The great expense of first cost and of repairs incurred by the use of large belts, together with an expensive equipment of large hangers and shafting, causing great waste due to friction, and the fact that one large engine is required to furnish power for the whole factory (as is the case in the great majority of factories throughout the country), whether heavy loads or light loads are to be taken from it, has brought out more prominently than would otherwise be the case, the economy with which a power plant driven by electric motors can be operated. With this end in view, the factories of the Western Electric company, Chicago, are being thoroughly equipped with electric motors, which are used to operate the several departments.

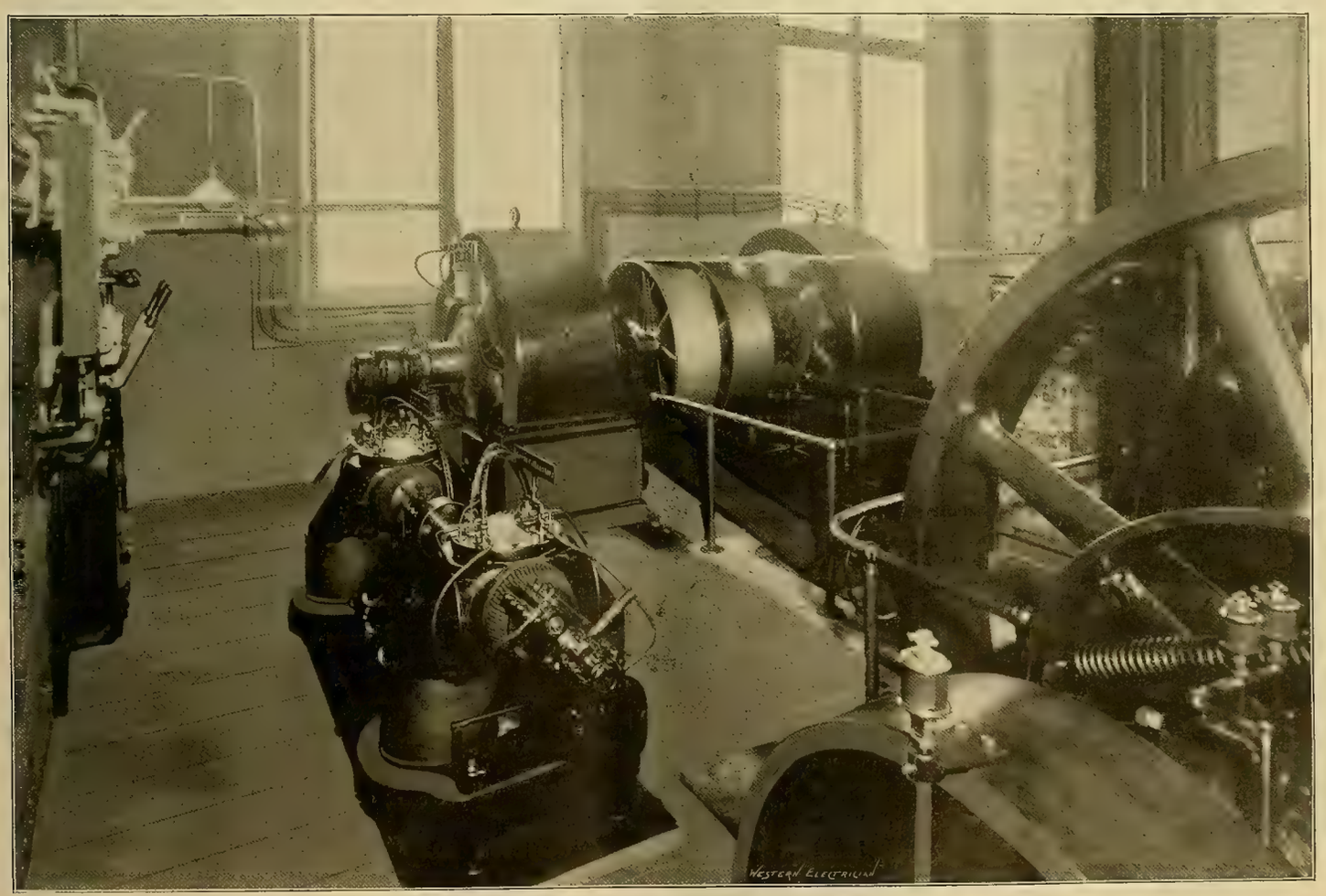


FIG. 1. ELECTRIC TRANSMISSION OF POWER IN CHICAGO.

In order to operate a system of this kind economically, the power plant is divided into units equivalent to the requirements of the factory. Thus, when it is only necessary to operate light loads, an engine and dynamo of suitable size can be arranged to carry, practically, a full load, at which point the efficiency of the plant is at its maximum. When additional power is required, another engine and generator can be started and run in multiple with the first generator. By thus adjusting the units, the machines can be operated at all times at full load, and a great saving in fuel made over the common custom of operating a large power plant at half or three-quarter load. The generating station in the Western Electric company's factories consists of two large Western Electric generators, belt connected to a medium high speed Russell engine. This plant is used to furnish power during the day and is run with a constant load at all times upon the machines. When it is desired to operate the plant at night, a small generator of 50 horse power capacity is driven from a 60 horse power Russell engine.

The illustration upon this page, Fig. 1, shows a view of the generating station. The engine is the latest type four-valve compound Russell engine of 300 horse power capacity. Placed upon the shaft of the engine are two large friction clutch pulleys by means of which either generator can be stopped or started at pleasure. The generators are of 150 horse power capacity each, compound wound, multipolar type, and slow speed, running at only 450 revolutions per minute. The machines are connected direct to bus bars placed on a marble switchboard, all the connections of which are placed on the front of the board where they can be easily inspected. The board is equipped with knife switches for opening and closing the circuits, with an ammeter, a voltmeter for reading the pressure, and a ground detector for indicating a ground when such is on the circuit. In addition there is connected to the bus bars a motor generator, which, taking the current at 220 volts, transforms it to 110 volts, and furnishes current for the lights used in the engine room and the adjacent machine shop. By transforming the current in this manner, the necessity of a separate engine is avoided. This motor generator consists of one 40 horse power motor and one 40 horse power generator coupled shaft to shaft on the same base frame. The motor is compound wound so as to vary the speed of the generator for varying loads. The generator is shunt wound. In this way a uniform voltage is maintained at the center of distribution of the light distributing circuits under any and all changes of load. The starting arrangement of this motor deserves special mention. An electro-magnet is placed on the main shunt circuit, the armature of which closes a switch in the main circuit. When the fuse blows, or the motor is stopped for any purpose, this electro-magnet is de-energized and its armature opens the main circuit. It is now impossible to start the machine until the lever is pulled over, which closes the main circuit switch, and at the same time inserts resistance into the armature circuit. The motor can then be started, the electro-magnet holding its armature in position. The lever can be used for cutting the resistance out of the armature circuit and the motor brought up to full speed. The intention of the device is to prevent starting of the motor at any time without first inserting resistance into the armature circuit, making it impossible for the motor to be started without first performing this operation.

The distributing board of the power circuit is separate and distinct from the board controlling the generators. This board is marble and contains knife switches for circuits running to each section of the building, thus placing every circuit under the direct control of the engineer. The circuits running from this switchboard to all the motors consist of lead covered cables, which are drawn into iron pipes, making a system of the highest possible insulation and of the greatest safety against injury from outside sources that can possibly be devised.

One of the interesting applications of electric power is in the room where a carbon crusher and blower is in operation. As seen by reference to Fig. 2, a 15 horse power vertical motor is used for operating the machinery. The advantage of this style of motor is the small floor space which it occupies, the size of this space including the sliding carriage and belt tightener being five by four

feet. In order to protect this motor from dust it is entirely surrounded by a casing of corrugated iron with a glass door, thus leaving the motor at all times open for inspection. The rheostat, ammeter and switch are placed outside of the casing. This motor is equipped with self-oiling ball and socket bearings and carbon brushes, and will run for days without attention. The motor is belted direct to a short piece of line shafting, on which are all the pulleys running to the machinery which it operates.

In Fig. 3 is shown a 35 horse power motor used for driving the machinery in the insulating department of the factory. This motor runs at 1,200 revolutions per minute, and is equipped with self-oiling bearings and carbon brushes. The arrangement of the line shaft and pulleys is such that by opening a clutch and throwing on a

FIG. 2. ELECTRIC TRANSMISSION OF POWER IN CHICAGO.

belt the shafting can immediately be connected to an independent driving plant operated by ropes. This furnishes an additional source of power, if for any reason it should be necessary to stop the motor. In Fig. 4 is illustrated a 10 horse power multi-bipolar motor, which is used to operate the machinery in the punching department. This motor is operated only when it is desired to run this department at night. By opening a friction clutch pulley the shaft is disconnected from the power plant run by the large engine, and permits the shafting to be run by the electric motor.

The most extensive application of motors is found in the machine shop, an idea of which is presented in Fig. 5. The power is divided up into units to fit necessities. One 35 horse power motor is used to run the shaft extending the entire length of the shop, from which power is taken to run all the small machines. Three independent motors of five horse power capacity each are used to drive the large machines, such as the boring mill, milling machine and planer. These motors are all placed on a platform over the belts, thus keeping them away from any pieces of iron which may be flying through the air, and not occupying floor space which is valuable for other purposes. On the other side of the machine shop is a 10 horse power

FIG. 3. ELECTRIC TRANSMISSION OF POWER IN CHICAGO.

motor which is used to run short lengths of shafting driving small machinery used for special purposes. A five horse power motor is also used for operating the elevator which carries material from the main floor to the gallery floor. Another five horse power motor is used for running the metal saw machine.

A 10-ton electric crane, Fig. 6, manufactured by Yale & Towne, Stamford, Conn., is operated in this room. The entire electrical equipment of this crane was manufactured by the Western Electric company, and consists of a five horse power traveling motor, a two horse power traversing motor and a 10 horse power hoisting motor. These motors are all of the multi-bipolar type, slow speed, and direct connected by means of worms and gears to the crane. The starting, stopping and reversing gear for these motors is unique. By one throw of the lever resistance is inserted into the armature circuit and the main switch is closed. Throwing the lever in the opposite direction reverses the motor. The Western Electric company at the present time has in operation 14 motors, aggregating 257 horse power, varying in size from two horse power to 40 horse power. All motors are wound to be operated at 220 volts pressure. The entire electrical equipment of this plant is of the highest grade and as an application of efficiency and convenience in work shop practice is of much interest. The entire system of line and counter shafting which was originally installed is being gradually suspended by electrical transmission and there are of course many applications in use of which mention has not been made.

A Statue in Honor of Morse.

The Washington correspondent of the *Chicago Record* says: "Edward Rosewater, the editor of the Omaha *Bee*, who is always suggesting some good idea, has come to Washington to ask an appropriation from Congress for the erection in front of the new congressional library here of a statue in honor of Samuel F. B. Morse, the inventor of the electric telegraph. It will be fifty years on the 24th of May since the first message was sent by electricity in the United States, and that over a wire erected between Washington and Baltimore, and Mr. Rosewater wants Congress to celebrate that anniversary by making an appropriation for the monument. The suggestion is very well received."

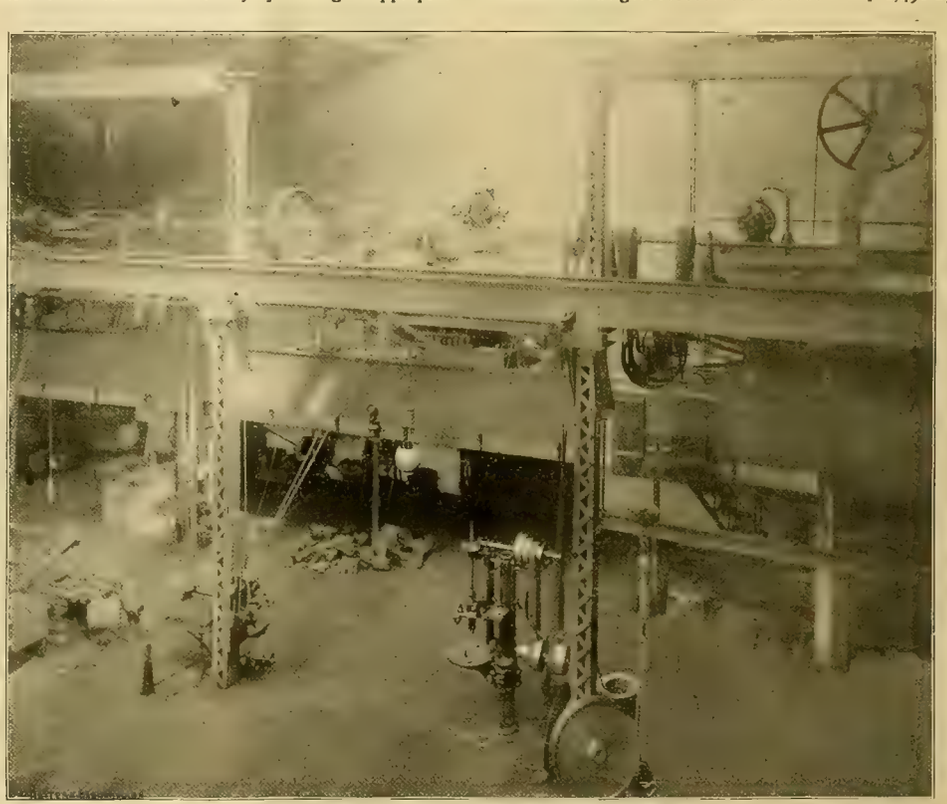


FIG. 5. ELECTRIC TRANSMISSION OF POWER IN CHICAGO.

The Trolley in Brooklyn.

There seems to be a revulsion of feeling on the trolley question in New York and Brooklyn, brought about, no doubt, by the malicious attacks that were made before it was given a chance to demonstrate its many advantages. Referring to the bill before the Legislature restricting the speed of motor cars, to which allusion was made editorially in this journal last week, the *New York Tribune* says:

The movement to restrict the speed of the trolley cars in Brooklyn to six miles an hour is clearly not in the public interest. The bill before the Legislature is aimed directly at Brooklyn, though it is a serious question whether Brooklyn can be classed with cities of less than 1,000,000 inhabitants. Judging by the growth of the city between 1880 and 1890, it is easy to believe that the population, which was 806,000 in 1890, is now fairly beyond the million point. But that is only a side issue. The main question is as to the speed of the trolleys. There is no doubt that when electricity first came into use last year these cars were run recklessly in many cases and at times at inordinate rates of speed. But no one can fail to notice that the number of accidents recently has been small. The motormen have become accustomed to work which was at first entirely novel, and the cars are run with much greater care. At the crossings of other railroads the rule now is that cars must be brought to a stop, or practically so; the motorman cannot go on until he has received a signal from the conductor. Still more important, perhaps, the people are getting educated to the difference between horse cars and electric cars, and the necessity of great care in crossing car tracks has been impressed by parents on their children. The cars have been provided with what are termed safety feeders, which doubtless tend to promise safety. The movement for a law to reduce the speed of these cars to six miles an hour undoubtedly originated with the elevated roads, which have suffered severely in consequence of the change of motive power on the surface lines. It is a purely selfish movement. The people generally do not favor it. In many parts of the city a speed of more than six miles is perfectly safe, provided the motormen are careful and keep a sharp lookout at street crossings and when meeting other cars. In lower Fulton street that speed is never attained during the daytime, as there are too many cars to make reasonable rapid progress possible. The pending bill ought not to become a law.

Interesting Electrical Statistics.

Hon. Carroll D. Wright, commissioner of labor, in charge of the completion of the eleventh census, has transmitted to the secretary of the interior a report which presents preliminary totals for all classes of mechanical and manufacturing industries in the United States, as prepared by the division of manufactures. The following are the statistics relating to the electrical industry:

ELECTRICAL APPARATUS AND SUPPLIES.

Number of establishments reporting	189
Aggregate of capital represented	$18,997,337
Total value of plant	$ 6,170,570
Value of land	$ 714,542
Value of buildings	$ 1,496 293
Value of machinery, tools and implements	$ 3 959 672
Live assets	$12,826,830
Miscellaneous expenses	$ 1,154,462
Average number of employes	9,485
Total wages	$ 5,366,188
Officers, firm members and clerks above 16 years, males	640
Wages for same	$ 826,986
Officers, firm members and clerks above 15 years, females	42
Wages for same	$ 22,152
Operatives, skilled and unskilled, above 15 years, males	6,221
Wages for same	$ 3,469,140
Operatives, skilled and unskilled, above 16 years, females	970
Wages for same	$ 243,039
Children operatives	44
Wages for same	$ 7,543
Pieceworkers, males above 16 years	1,068
Wages for same	$ 613.707
Pieceworkers, females, above 15 years	499
Wages for same	$ 183,621
Children pieceworkers	Not any
Cost of material used	$ 8,819,498
Value of products, including receipts from custom work and repairing	$ 19,114 714

The statistics under the following classification are confined to the city of New York, the District of Columbia and the city of St. Louis. Commissioner Wright stated that it was found impracticable to make a complete canvass of the entire United States for the collection of statistics pertaining to the generation of electricity for lighting and power purposes:

ELECTRIC LIGHT AND POWER.

Number of establishments reporting	144
Aggregate capital represented	$33,838,549

Total value of plant	$19,167,012
Value of land	$ 1,743 017
Value of buildings	$ 2,106,418
Value of machinery, tools, and implements	$15,317,577
Live assets	$14,671,537
Miscellaneous expenses	$ 755,201
Average number of employes	2,004
Total wages	$ 1,556,623
Officers, firm members and clerks, males above 16 years	205
Wages for same	$ 268,325
Officers, firm members and clerks, females above 15 years	1
Wages for same	$ 3,056
Operatives, skilled and unskilled, males above 16 years	1,791
Wages for same	$ 1,284,502
Operatives, skilled and unskilled, females above 15 years	1
Wages for same	$ 240
Children operatives	2
Wages for same	$ 500
Pieceworkers, males above 16 years	Not any
Pieceworkers, females above 15 years	Not any
Children pieceworkers	Not any
Cost of materials used	$ 1,155,789
Value of products, including receipts from custom work and repairing	$ 4,783,224

ELECTROPLATING.

Number of establishments reporting	313
Aggregate capital represented	$ 2,051,134
Total value of plant	$ 888,173
Value of land	$ 155,760
Value of buildings	$ 129,420
Machinery, tools and implements, value of	$ 602,993
Live assets	$ 1,162,961

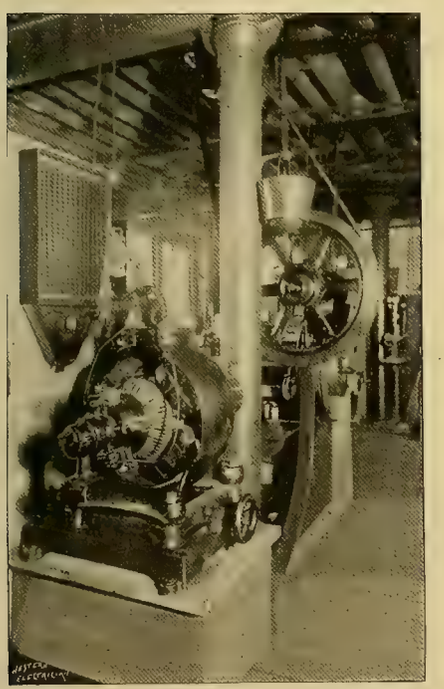


FIG. 4. ELECTRIC TRANSMISSION OF POWER IN CHICAGO.

Miscel'aneous expenses	$ 182,826
Average number of employes	2,162
Total wages	$ 1,260,475
Officers, firm members and clerks, males above 16 years	388
Wages for same	$ 364,115
Officers, firm members and clerks, females above 15 years	9
Wages for same	$ 4,608
Operatives, skilled and unskilled, males above 16 years	1,529
Wages for same	$ 802,578
Operatives, skilled and unskilled, females, above 15 years	87
Wages for same	$ 28,152
Children operatives,	68
Wages for same,	$ 13,794
Pieceworkers; males above 16 years,	73
Wages for same	$ 43,750
Pieceworkers, females above 15 years,	8
Wages for same,	$ 3,478
Children pieceworkers	Not any
Cost of materials used,	$ 1,048,057
Value of products, including receipts from custom work and repairing	$ 3,121,642

GALVANIZING.

Number of establishments reporting	27
Aggregate capital represented	$ 1,301,973
Total value of plant	$ 464,593
Value of land	$ 144,300
Value of buildings	$ 128,900
Value of machinery, tools and implements	$ 191,393
Live assets	$ 837,380
Miscellaneous expenses	$ 99,192
Average number of employes	846
Total wages	$ 473,111
Officers, firm members and clerks, males above 16 years	83
Wages for same	$ 110,233
Officers, firm members and clerks, females above 15 years	2
Wages for same	$ 1,000
Operatives, skilled and unskilled, males above 16 years	733
Wages for same	$ 349,228
Operatives, skilled and unskilled, females above 15 years	4
Wages for same	$ 880
Children operatives	11
Wages for same	$ 3,650
Pieceworkers, males above 16 years	13
Wages for same	$ 8,120
Female pieceworkers, above 15 years	Not any
Children pieceworkers	Not any
Cost of materials used	$ 1,940,712
Value of products, including receipts from custom work and repairing	$ 2,957,143

Electric Franchise Fight in San Francisco.

A peculiar case which really involves a settlement of the question whether it is possible for any electric lighting company other than the Edison Light & Power company of San Francisco to carry on an extensive electric lighting and power business in that city, recently came up for hearing before Judge Hebbard, of Department 4 of the Supreme Court of the city and county of San Francisco. The action was brought by the Pacific Power company against the chief engineer of the fire department and the city and county of San Francisco, and is the final hearing of a preliminary injunction granted two years ago, restraining the fire department from cutting down the house top circuits of the Pacific Power company. These were erected in violation of municipal ordinances, as it was impossible for the Pacific Power company to secure a municipal franchise granting them the privilege of erecting pole lines.

When the ordinance was enacted two years ago four different electric companies maintained house top wiring in San Francisco; namely, the California Electric Light company (now the Edison Light & Power company), the Electric Improvement company, the Pacific Electric Motor company, and the Pacific Power company. In compliance with the formal notification of the chief of the fire department the California Electric Light company promptly removed its house-top wiring to its pole lines; the three other companies secured preliminary injunctions and the matter became tied up in the courts for a while. Since then the Electric Improvement company has sold out to the Edison Light & Power company, the Pacific Electric Motor company occupies pole lines of and buys electric power from the Edison Light & Power company by virtue of a contract and recently the suits of the Electric Improvement company and the Pacific Electric Motor company have been dismissed by mutual consent, but on March 30th the hearing of the matter of the Pacific Power company came up as stated.

The plant operated by the Pacific Power company was installed by N. S. Keith over eight years ago. It consists of four constant current dynamos of 40 nominal horse-power each. The machines are really relics of some of the Prof. Keith's experimenting. The current is regulated between 14 and 16 amperes by means of a solonoid dash pot and brush rocker regulator, while the fields are in plain shunt and consist of something like 14 miles of No. 28 wire. Their regulation is therefore, a sort of a cross between automatic and a small-boy-with-hand-on-rheostat-to-watch-the-ampere-meter. The motors on the circuit are all of the Keith constant current type.

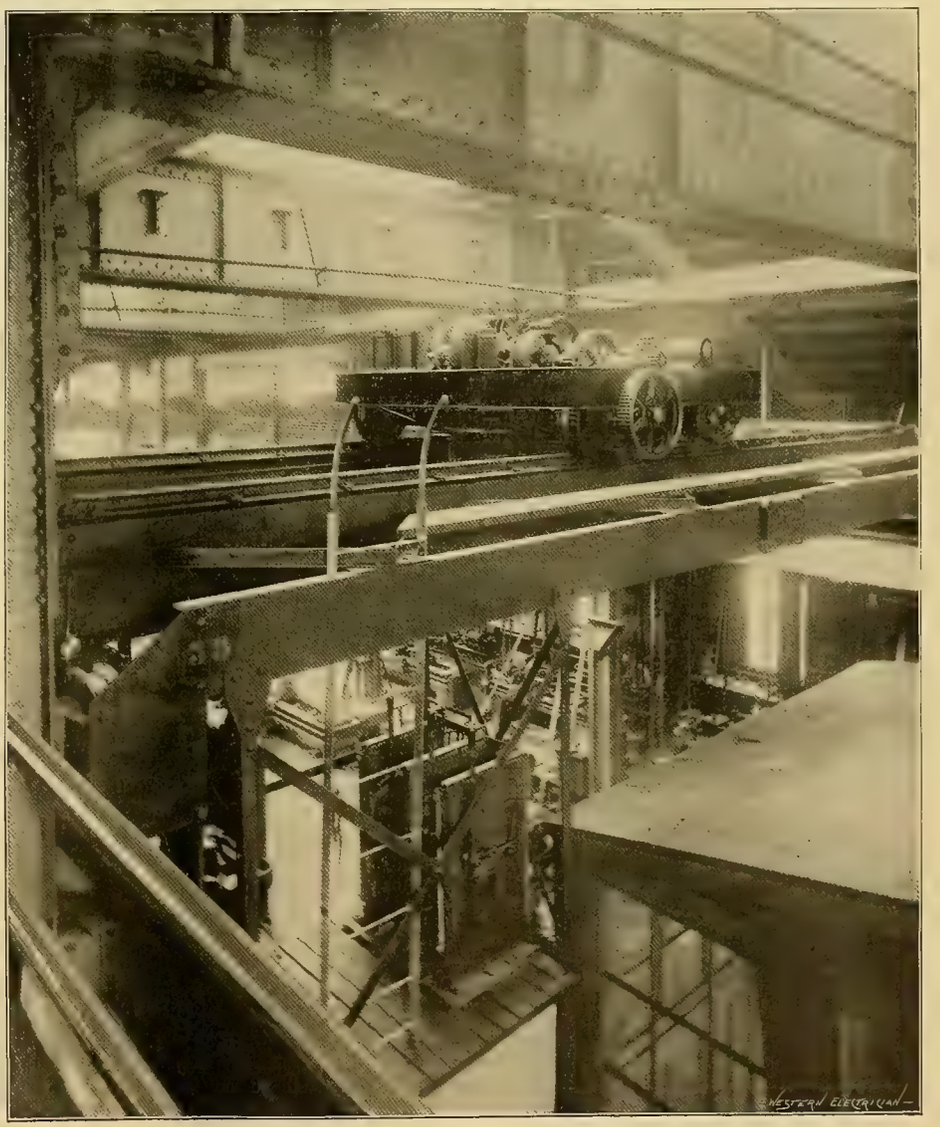


FIG. 6. ELECTRIC TRANSMISSION OF POWER IN CHICAGO.

George P. Low, electrical inspector of the Pacific Insurance Union and consulting electrical engineer, was the first witness called upon behalf of plaintiff. He had measured the potentials of the various circuits of the Pacific Power company and found the normal working voltages of the circuits to vary from 400 to about 700 volts. In the insulation resistances were found to vary from 2.9 megohms to 9.4 megohms. All circuits were of underwriters wire, but were run and maintained in excellent condition. Witness testified that in his opinion these

particular circuits so far as their voltage was concerned, and from the standpoint of personal hazard, were the practical equivalent of an electric railroad system. The house-top circuits were all supported on at least eight foot posts which were in accord with the requirements of the Underwriters International Electric Association and the National Electric Light association. That portion of Mr. Low's testimony which appeared to be of particular interest was his opinion as to the relative merits of house top and pole line construction. The witness maintained that from the fireman's standpoint it was far better that all wires of every nature should be placed on iron racks or posts firmly secured to the fire walls of buildings, and running wires at least seven feet above roofs. The reason was that the wires would then be entirely beyond interference from ladders or streams of water against the sides of buildings; that therefore it would never be

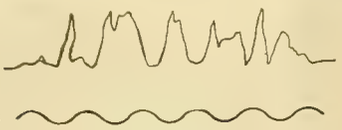


FIG. 1. INVENTION AND DEVELOPMENT OF THE TELEPHONE.

necessary to cut great pole lines of wires in order to place ladders and, in brief, wires so placed would offer no interference or intimidation to firemen.

It was also brought out in evidence that the Pacific Power company had placed in its station a gong connected with the tapper circuit of the fire alarm telegraph system, and that upon receipt of an alarm of fire in the immediate vicinity of any of its circuits, that circuit was promptly cut out. It was further stated that as an additional safeguard each dynamo was equipped with a magnetic break which operated so as to take all potential from the line should it be cut or broken in any way. The device referred to is simply a magnetic break consisting of a simple magnet actuated by the line current which, when broken, released an armature that opened the field coil.

A. J. Bowie, manager of the Electric Improvement company until the time of its absorption by the Edison Light & Power company, also testified, strongly favoring house-top construction. This company operated about 650 arc lights and from 8,000 to 10,000 incandescents, all on house-top wires, and in answer to the question as to which, in his opinion, would be the safer method of transmitting power, by pole lines or on house tops, Mr. Bowie replied, that "Wires erected on structures properly constructed on housetops are brought above and beyond all telegraph and telephone wires, and one of the principle difficulties which arise in the transmission of electric light and power is due to the fact that these small wires are sometimes broken and thrown across electric light and power circuits on pole lines with consequent short circuiting and burn-outs. Placing electric light wires on properly constructed structures on house tops, put them above all such difficulties. The experience of the Electric Improvement company, was

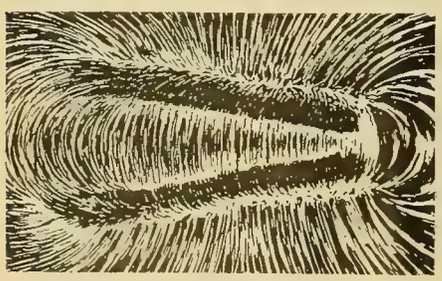


FIG. 2. INVENTION AND DEVELOPMENT OF THE TELEPHONE.

that during all the heavy storms which prevailed in San Francisco the house top lines were never damaged or blown down and its lights were not interrupted at all in comparison with those operated on pole lines."

When the chief of the fire department, D. T. Sullivan, was called, it was believed that being the complaining witness he would severely arraign the propriety of house-top wiring, but instead it was found that his evidence proved a boomerang. Evidently the testimony previously offered had impressed the chief engineer favorably.

"Could you not, with the assistance of a good electrical engineer make a system that would render the system perfectly safe and free from any intimidation to firemen?" was asked the chief in cross examination.

"Well, when I referred to Mr. Low's frame I meant to say that his ideas, if carried out correctly would improve the present system wonderfully."

"Don't you think frankly that it would make a safe system?"

"It would make a very safe system in my judgement from what I know of it."

A little further on Chief Sullivan in again alluding to the suggestion said that house-top wiring if carried out as indicated "would be a big improvement on what we have."

This concluded the testimony and final argument was postponed.

Invention and Development of the Telephone.[1]

By Herbert Laws Webb.

The transmission of sound by electricity is effected by means of undulatory currents; that is, currents continuously varying in strength and direction. A sound wave produced by articulate speech may be represented by a wavy line, Fig. 1, now bending up and now downward, and with an infinite number of little humps and bumps at all parts of the main curves. In order, then, to reproduce such waves by means of electric currents, it is necessary to transmit currents having similar undulations and similar minute humps and bumps, and having also the same rapid variation of undulations that are present in the sound waves.

The intimate relation between magnetism and electricity provides a means for producing these undulatory currents in the simplest possible manner. A steel magnet produces in its neighborhood what is known as a magnetic field, Fig. 2. We imagine the air surrounding the magnet to be permeated by what are called lines of force, which radiate most thickly from the poles. If a wire be moved about within the influence of these lines of force, a current of electricity will be set up in the wire, Fig. 3. If the wire be held still in proximity to the magnet and any change take place in the strength of the magnet (causing a change in the lines of force) a current will be set up in the wire. However slight the movement of the wire or the change in the strength of the magnetic field, currents will be set up in the wire.

Prof. Bell, in the course of his experiments, many of which are of the greatest interest as showing the develop-

FIG 3. INVENTION AND DEVELOPMENT OF THE TELEPHONE.

ment of the electric speaking telephone, arrived at this combination. He took a steel bar magnet and placed at one end of it a spool wound with insulated very fine copper wire. In front of the end of the magnet, and very close to it, he placed a diaphragm of thin sheet iron. The ends of the coil of copper wire were connected to two line wires, which at their distant end were joined to the coil of a similar arrangement, Fig. 4. The diaphragm, on being thrown into a state of vibration by the sound waves produced near it, caused a succession of rapid changes to take place in the magnetic field surrounding the coil of wire, thus setting up currents in the coil. As the changes in the magnetic field corresponded exactly to the vibrations of the diaphragm, which in turn were identical with the sonorous vibrations communicated to it through the air, the electric currents produced in the coil necessarily corresponded in all particulars to the sound waves. Consequently, these currents being transmitted along the line wire to the distant coil produced changes in the magnetic field there similar to the changes which produced them, resulting in a vibratory movement of the diaphragm, which, setting in motion the surrounding air, caused the reproduction of the sound waves communicated to the first diaphragm.

A reference to the field of the Bell telephone as shown in the diagram, Fig. 5, will help to make clear the following description of the theory of its action, and also to emphasize some practical points in connection with magnet telephones. The diaphragm, being placed close to the magnet, becomes magnetized, and, as it were, part of the magnet itself, and the lines of force spread from the diaphragm back to the magnet, some of them passing through the coil. When the diaphragm is set in vibration by the sound waves directed to it, the lines of force are disturbed or distorted, and the effect is to produce minute currents of electricity in the coil. It is probable that a movement of the diaphragm toward the magnet strengthens the part of the field in which the coil is situated and condenses, as it were, the lines of force in that neighborhood, causing a current of one direction to be set up in the coil, while a movement of the diaphragm away from the magnet weakens that part of the field, spreading out the lines of force, and produces a current of opposite direction. This explanation is not held by many to contain the whole theory of the action of the Bell telephone, as it is considered that the effects produced in the transmission of speech are too remarkable to be accounted for by the very feeble currents that can be generated in such a way. Researches by various scientists indicate that there is also molecular disturbance in the diaphragm and magnet, which in part accounts for the wonderful efficiency of the transmission.

Considering, however, solely the theory just explained, we see that to get good transmission we need: (1) a powerful magnet, so as to have a strong magnetic field; (2) a diaphragm capable of vibrating freely so as to cause a wide range of vibration in the distribution of the lines of force; (3) a wide, shallow coil, so as to place as much of the wire as possible within the influence of the lines of force that are subject to variation by the movement of the diaphragm. These points are worth bearing in mind in the construction of magnetic telephones.

1. From advance proofs of "The Telephone Hand-book," published by the Electrician Publishing company, Chicago (now in press). Price, $1.

MAGNET TELEPHONES.

All magnet telephones—that is, telephones employing permanent magnets and iron diaphragms—are simply variations of the original Bell instrument. The Bell telephone, even in its simplest form, is a most wonderfully sensitive instrument. Many experiments have been made with a view to determining exactly how sensitive it is, or what is the minimum amount of current that will produce a sound in the telephone. Mr. Preece has found that an ordinary receiver will respond to a current of six ten-thousand-millionths of a milliampere. In other words, the current absorbed by a sixteen candle power incandescent lamp would be sufficient, if sub-divided into such minute currents,

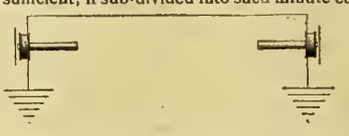


FIG. 4. INVENTION AND DEVELOPMENT OF THE TELEPHONE.

of producing sounds in thirty billion telephones. It is obvious that nothing remains to be done in the way of improving the delicacy of such an inconceivably sensitive instrument. It is the opinion of Professor Silvanus Thompson that we ought, on the contrary, to use less sensitive receivers and more powerful transmitters. Such receivers, he argues, would be less responsive to foreign currents that invade telephone lines, and would still be operated by the voice currents from powerful transmitters. This suggestion has not been adopted, as, although more powerful transmitters have been introduced from time to time, no use has been made of less sensitive receivers.

The modifications that have been made in the Bell telephone have been in the direction of making it more powerful, so as to enable it to reproduce more clearly the delicate overtones or timbre vibrations of the human voice, and to give louder and more distinct articulation generally. Any modifications that can be made in such a simple instrument are obviously limited to very few directions. The magnetic field can be strengthened by using a stronger permanent magnet; the amount of wire in the coil under the influence of the magnetic lines of force can be increased, and the diaphragm can be made more responsive to vibrations, and its vibrations productive of greater effect on the coil. This last naturally follows from strengthening the field, because, as the diaphragm is magnetized by induction from the magnet, a stronger magnet will magnify the effect of the vibrations of the diaphragm on the coil. Any alteration in the thickness of the diaphragm with the idea of rendering it more responsive to vibrations has practically no effect. Indeed, it has been found that telephones will speak well even with diaphragms several inches thick, and this lends considerable weight to the theory that molecular disturbance plays an important part in the action of the telephone. We find, then, that modifications of the magnet telephone are practically limited to the magnet and the coil, and it is in this direction that improvements have been made, as we shall presently see.[1]

Wiring of Ships.

To the Editor of the Western Electrician:

Your recent editorial calls to mind a subject that should not longer go unnoticed—the absolute safe installation in electrical plants on shipboard. But when this matter is

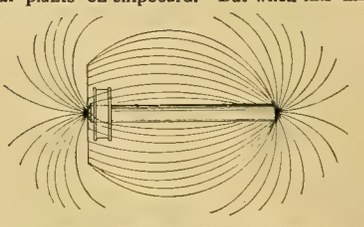


FIG. 5. INVENTION AND DEVELOPMENT OF THE TELEPHONE.

broached to those who are interested a sudden quietus is put upon it. Probably no man in the United States or Europe has given more attention to the subject of safety in insulation than the writer. And above all places where absolute safety should be required and maintained in this direction, the ships should be first. Carelessness, however, is apparent on every hand, and in most cases ignorance is manifested by the men in charge of this special department. The writer had occasion to cross the Atlantic one year ago, and when in mid-ocean the wires on the steamship Etruria short-circuited and the smell of burning rubber filled the staterooms. On getting up and going into the passage-way I met a number of excited people, who were greatly alarmed at the fire and smell of smoke. Finally the second engineer, I believe, came to explain matters. He said he had now turned off the current and would fix it up soon. On talking with him later I learned that that was not the first time and was no unusual thing.

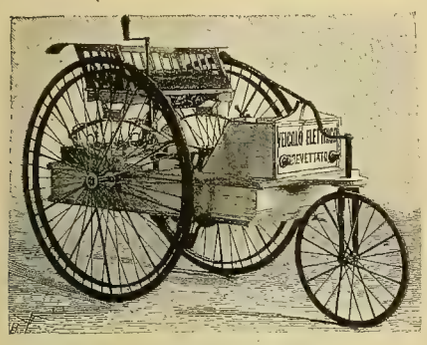
It will be remembered that in August, 1892, the steamship City of Japan, when 800 miles at sea, was obliged to put back to China, owing to a fire caused by the burning

1. The book also describes and illustrates a number of other forms of magnet telephones.

of insulating material on overheated wires. The fire burned four days in her hold. Many other cases could be cited, but it is not necessary. The only preventative against this danger is to use a water-proof and fire-proof insulated wire and have it of large carrying capacity and well installed. But there the difficulty comes again; the great *Poo Bah* will say there is no necessity to use anything but the cheapest, and so we keep right on paying insurance and endangering lives. C. T. S.

Italian Electric Carriage.

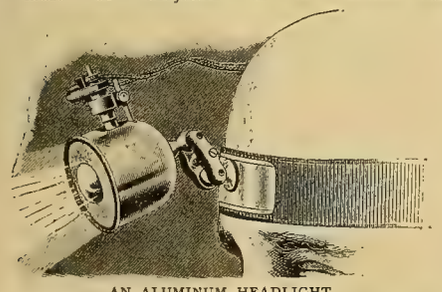
The problem of constructing a carriage operated by mechanical means which would meet the requirements for speed, reliability, economy and durability has been made the subject of study by so many engineers and inventors that almost every country contains the results of



ITALIAN ELECTRIC CARRIAGE.

investigations and trials. Numerous prizes have been offered for a successful, practicable vehicle automatically operated, and recently the *Petit Journal* instituted a competition which gathered in Paris representatives of almost every type of vehicle, including exponents of propulsion by means of steam, gas, oil and electricity. This last method was, without doubt, that which presented the most points of excellence for large cities which possess central stations for the distribution of electrical energy. For travel between cities it is hard to believe that such a substitute will soon displace the steam railroad, but in cities, where the roads are usually even and where its applications may be mulitplied indefinitely, there is every reason to look for the advent of the electric carriage in time.

Among the recent inventions in this line *La Nature*, from whom the accompanying cut is reproduced, notes an electric vehicle concerning which Prof. G. Milani, of the University of Piso, writes at some length. The carriage was made at Castelnuovo (Garfagnana) in the weaving establishment of Count Joseph Carli, a member of the Italian parliament. As seen by reference to the cut the carriage is a three-wheeled vehicle with a steering arrangement very similar to that on an ordinary tricycle. It is made in two styles, the one here represented being the more pretentious. The motive power is furnished by accumulators of the Verdier type, "chosen," writes Prof. Milani, "because it is possessed of a large specific capacity and because it is built with particular efforts having been taken to make it durable in order that it could, to a great measure, withstand the inevitable shaking to which it must be subjected in a vehicle des-



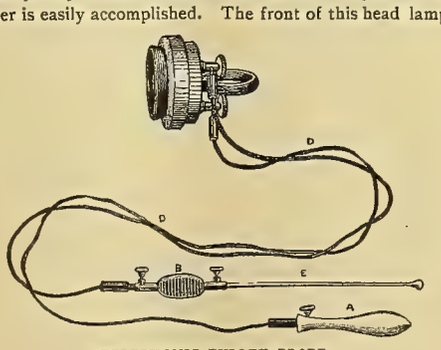
AN ALUMINUM HEADLIGHT.

tined to encounter all conditions and qualities of roads." The battery is composed of 10 elements, each having a capacity of 100 ampere hours or about 200 watt hours, giving a capacity for the entire battery of two kilowatt hours. The cell employed weighs five kilogrammes and contains five plates; under the conditions of normal discharge, the battery furnishes a current of five amperes, that is one ampere per kilogramme. The plates are placed horizontally in a wooden box and are held in position by an ebonite support. Parafinned jute in strips which separate one plate from another is used as an insulation between the electrodes, the whole being contained in a small ebonite box with the cover securely fastened in place, so that the electrolyte will not be spilled from the effect of the shaking of the wagon. The inventors are satisfied of the advantages to be gained by slow charging, and therefore a very weak current is employed, taking from 25 to 30 hours to store, which makes it possible for primary batteries to be utilized for this purpose. This method of charging, they claim, permits of obtaining a better output and a better rate of discharge of the accumulator, although the external resistance might vary to a considerable degree. Experience has proven that a rapid discharge does not cause any harmful results, and is not attended by any marked deterioration in the positive plates. The wagon complete weighs 160 kilogrammes.

The motor is geared directly to the axle of the rear wheels. It takes in the neighborhood of 550 watts, and the battery is capable of furnishing energy to the motor for a four to five hours' trip. The motor is shunt wound and can be easily utilized for charging the accumulators by reversing its action and running it as a dynamo. There is a system of gearing between the axle of the motor and the axle of the wheels. By means of this gearing one can, by turning a crank, regulate the speed of the motor to a suitable number of revolutions a minute. What advantage can be gained when running down an incline is thus provided for, but it is doubtful if the plan is of much practical importance.

An Aluminum Head Light.

The illuminator, which is illustrated in the accompanying cut, is made almost entirely of aluminum and is so light that its weight is scarcely perceptible on the head, the whole apparatus complete, weighing but three-fourths ounces. The thin German silver plate to which is sewed the head band, is connected to the hyperbolic reflector by a universal joint, enabling the operator to change the position at will, either higher, lower or to either side, and again, from any of these positions to direct the rays at any angle. The lamp proper is supported inside the reflector by another universal joint, allowing of the focusing of the light and rendering the removal of the lamp extremely simple. This substitution of one lamp for another is easily accomplished. The front of this head lamp



TELEPHONIC BULLET PROBE.

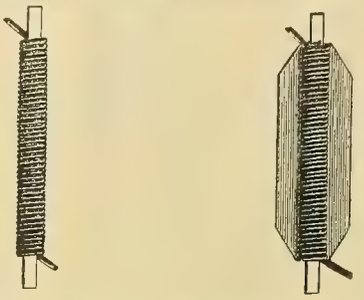
consists of a disk of glass, in the center of which is the lens which throws a strong and concentrated light on the point of operation. The edges of the disk are ground glass, so that a diffused light is shed upon the surface immediately surrounding the point most brilliantly illuminated, instead of its being in total darkness. A light, flexible cord runs back over the ear to a storage battery near by. This apparatus will be found extremely useful by surgeons in operating on the eye, ear and throat and internal cavities of the body. It is manufactured by the Union Electric company, New York.

Another Early Transformer with Closed Magnetic Circuit.[1]

By A. M. Tanner.

Another contribution to the early history of transformers, or inductoriums possessing closed magnetic circuits, is the British patent of Thomas Allen, dated January 24, 1852, No. 14,190. The specification of this patent states that "the first part of my invention consists of improvements in producing induced electric currents by means of electro-magnets, which currents are applicable to various useful purposes. For the purpose of thus producing induced electric currents I compose an electro-magnet, or combination of electro-magnets, of several straight pieces of soft iron so as to form an electro-magnetic circle, and I prefer to form such magnet or combination of four pieces, but it may be composed of three pieces, or of five or more such pieces. I cover these pieces with the primary coil of insulated wire and then place the secondary coil, also of insulated wire, around the primary coil and the pieces being straight they may have the coils wound upon them in a lathe with great facility. The pieces, having had the coils put upon them, are then to be connected together at their ends so as to form, when electro-magnetised, a complete electro-magnetic circle. The wires of the primary coils are then to be connected together so as to form one continuous primary coil, the two ends of which may be connected with a battery in the ordinary manner. The wires of the secondary coils around the pieces of the magnet or combination are also to be connected, so as to form one continuous secondary coil, the two ends of which are to be connected with the line wires of an electric telegraph apparatus, or with the wires of any other apparatus to which the same may be intended to be applied.

"In figures 1, 2 and 3, I have shown the mode of constructing an electro-magnet, or combination of electro-magnets of this description with four straight pieces of soft iron. Fig. 1 shows a straight piece of iron with the primary coil wound upon it, the ends projecting a little beyond the coils. Fig. 2 shows the same straight piece of iron with the secondary coil also wound upon it, and the end of each of the coils are left long and projecting so as to be ready to be connected with any other wires. Fig. 3 represents four straight pieces of iron with primary and secondary coils around them, as already described, and the pieces joined together at their ends by nuts, screws, or other means so as to form an electro-magnet. The primary



FIGS. 1 AND 2. ANOTHER EARLY TRANSFORMER WITH CLOSED MAGNETIC CIRCUIT.

coils around the pieces are also joined together so as to form one continuous primary coil, the ends of which are shown projecting and ready to be connected with the wires of the galvanic battery, which may be intended to be used. The secondary coils are also joined together in like manner so as to form a continuous secondary coil the ends of which are shown projecting and ready to be connected with the wires of any apparatus to which the induced current of electricity may be intended to be applied."

The patent drawing relating to the transformer part of the invention is reproduced to illustrate the construction, which is very much like that of some modern transformers in which the primary and secondary coils are wound continuously in the same direction on the core sections. It will be seen that the description is silent as to the lamination of the core sections.

Telephonic Bullet Probe.

In the accompanying cut is illustrated an electrical invention which possesses the distinction of being unique and an article which is of practical use in the field of surgery. The development of electrical science in recent years has been an important factor in the revolution of medical and surgical methods, and this instrument, known as a telephonic bullet probe, may prove to be far-reaching in its usefulness and applications. It consists of an ordinary telephone receiver, a common metal probe, an extra bulb of the same metal that the probe is built of and the connecting wires. The metal bulb is placed in the wounded person's mouth, the telephone receiver is held to the surgeon's ear and the probe is inserted in the wound made by

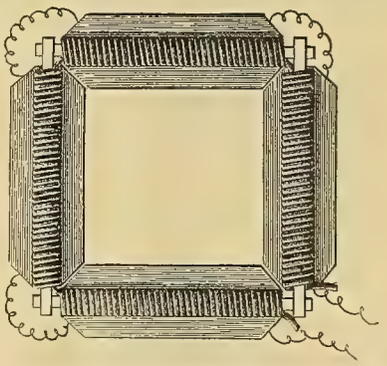


FIG. 3. ANOTHER EARLY TRANSFORMER WITH CLOSED MAGNETIC CIRCUIT.

the bullet. Nothing will be heard until the probe touches the bullet, when there will be heard a distinct rasping, grating sound in the receiver. Needles may be used to replace the probe when the course of the bullet has been so tortuous that it cannot be followed by the probe. The device is the invention of Dr. John H. Girdner of New York, and has been adopted as a standard in the United States army and navy and the German army.

The municipal council of Victoria, B. C., has adopted an ordinance under which the sum of $55,000 is to be expended for the installation of a municipal electric lighting plant.

1. From the London *Electrical Review*.

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WHEN the subject of holding branch meetings of the American Institute of Electrical Engineers was broached, those who favored the project advanced the argument that this arrangement would enable the outside members to participate in the same advantages that the New York members enjoyed—the papers being read and discussed simultaneously at both meetings. Already it has been found inconvenient to fulfill the terms of this agreement, and, of course, the New York members—or, rather, the "Institute"—have disregarded the compact. The last announcement card, issued from headquarters April 14th, contains the information that on Wednesday, April 18th, "the eighty-sixth meeting of the Institute will be held" at New York. It is further explained that the paper of the evening will be "fully illustrated with lantern slides." The announcement continues: "In order to utilize the lantern slides at Chicago the meeting of the western members in that city will be deferred until Wednesday, April 28th, at 8 P. M." At that time the Chicago members will be accorded the privilege of reading and discussing the paper presented the week before in New York, and possibly they may be given the benefit of the New York members' views on the subject.

ELECTRIC transmission of power and the advantages of using electric motors in the operation of factories are practically illustrated in the plant which is described elsewhere in this issue. The development of this branch of the electrical business has not received the attention which might be expected for it. There are many factories in Chicago, for instance, which might utilize a system similar to that employed in the case under consideration. The inducements offered to manufacturers and owners of buildings in which power is employed need not be repeated here. With a general introduction of motors there would be a noticeable abatement of the smoke nuisance which has been such a source of annoyance in Chicago. The entire community is concerned in anything that promises relief. In all large cities the introduction of electric motors should be encouraged as the surest means of abolishing the smoke nuisance.

BROOKLYN trolley roads will continue to run at the usual speed, and the elevated companies of that city will be obliged to compete with the surface roads upon their merits. Finding it impossible to secure the assistance of the Brooklyn members of the Legislature the elevated companies' representatives have discontinued their efforts in this direction, greatly to the satisfaction of the people. In this connection it is interesting to note the change of front on this subject which the *Tribune* presents. In a recent issue the following editorial note appeared: "The people of Brooklyn are getting used to the trolleys and like them well, and would have a most bitter feeling toward any one who should cause these cars to run no faster than the horse cars which they have superseded. The whole matter is one which Brooklyn is abundantly able to take care of without assistance from Albany." The same paper says that the service has been greatly improved, that with the appliances now employed and the experience acquired by the motormen in handling the cars the trolley system of Brooklyn is giving satisfaction to the people of that city. This has been the experience of other communities. Wherever the trolley has been given a fair trial it has gained public favor. This fact seems to have impressed some of the property owners of Chicago, for they refuse to be misled by the erroneous statements of the daily papers, and they are insisting upon the passage of the trolley ordinances. For instance, on last Saturday evening a meeting of business men and property owners on Halsted street, one of the principal business thoroughfares of the West Division, determined to petition the council for improved street railway service. The meeting instructed the aldermen who represent that district to procure the introduction of the trolley system on this line at any cost. It was the only system upon which they could rely for first-class service. The experience of the people of the West Side with the cable has not been of a character to fill them with confidence.

THE communication sent by Mayor Gilroy to the New York Legislature, in which he so positively expressed his disapproval of both the rapid transit bills which have been introduced in that body, was unquestionably the most unpopular action he has ever taken. It has been made the subject of criticism by many representative bodies which are working for the accomplishment of rapid transit and that of the Chamber of Commerce, written by Abram S. Hewitt, was particularly severe. The mayor, in presenting the financial situation, was too positive in his assertion that the underground rapid transit railway provided for in the Chamber of Commerce bill would cost $100,000,000. Competent engineers estimate the cost at about half the sum mentioned in the mayor's letter. It is not necessary to increase the debt of the city at once by the total cost of the road, a fact which seems not to have been taken into consideration by Mr. Gilroy. The city's bonds would be issued only as money was called for in the progress of the work from year to year, and the taxable valuation of the city would probably increase in an annual ratio broad enough to avoid conflict with the constitutional limitation. The constitutional limit of debt is 10 per cent. of the real estate valuation. Last year this valuation was estimated at $1,562,582,393, and the annual increase is from $50,000,000 to $60,000,000. The constitutional limit of debt at the present time is $156,258,239, and the actual debt on January 1st, according to the mayor's message, was $100,762,407.51. There is, therefore, a margin now of more than $55,000,000. It is to be considered that the financial plan of the Chamber of Commerce bill provides for the payment of the interest and principal of the bonds issued for rapid transit construction from the proceeds of operating the roads and involves no addition to the burden of taxation, while in process of time the roads themselves would belong to the city, being entirely paid for by the use of the franchise of operation.

The arguments of the mayor do not seem to carry weight. His announced opposition to the bills would tend to indicate that there is a strong probability in his mind of the passage of the Chamber of Commerce bill. It is to be hoped that the Legislature will not be influenced by his statements. The duty of that body seems to be to pass a measure which has for its object the accomplishment of such a public necessity as rapid transit, and which has received the emphatic approval of the New York press and people without reference to the wishes of the mayor and the other city authorities.

THE relative merits of the American and English patent systems are being discussed quite freely by inventors and patent experts. An interesting contribution on this subject is a communication on the "Origin of the Incandescent Lamp," by Henry S. Maxim, in London *Industries.* Mr Maxim relates his experience in attempting to secure a commercial incandescent lamp. He had been engaged in 1877 by Spencer D. Schuyler of New York to take charge of experimental work in this line. Mr. Schuyler had great faith in the future of electric lighting, although at that time there was no practical electric light. Mr. Schuyler had, however, employed two "electricians" named Sawyer and Smith to conduct experiments, but they had made no progress. Mr. Maxim asserts that Sawyer had been practicing deception upon his employer, palming off as inventions devices made from descriptions published in French papers. Maxim thoroughly investigated the subject and made a report to Mr. Schuyler in which he expressed the opinion that the failure to produce a practical incandescent lamp was due to the fact that "there was always some oxygen present in the globe." He expressed the belief, too, that "a carbon would not be rapidly destroyed by being heated to incandesence in a perfect vacuum or one approximately perfect." He suggested in this report that the best way to make these lamps would be to first charge them with gas and to pump the gas out perhaps several times in order that the gas, as it were, might wash the air away with it and then leave just sufficient gas in the globe to build the carbon up slightly. Maxim could see no reason why platinum wires should not be used for conducting the current into the lamp. He explained that "these wires should be melted into the glass exactly as in Geissler tubes." Maxim claims that his position was opposed by his associates and that Sawyer warned Mr. Schuyler that the proposed experiments were dangerous and that if any attempt was made to carry them on they would undoubtedly result disastrously and probably fatally injure those conducting them. The experiments were made, however, in the presence of Prof. Van der Weyde, and they were successful. Maxim then made a model of a lamp embodying this principle, and applied for a patent on October 4, 1878. The model was made directly after the first report was prepared, but so much was said against it that the application was not filed till about a year later, when a practical demonstration had been made. It was at this time that Maxim had an unpleasant experience in the patent office. He says:

About two or three months after my application was filed, Sawyer, learning that the experiments had been successful, applied for a patent on the same invention; and when the case came to trial he swore that he had got it up about a year previous to myself, and produced several witnesses to swear to it. The case was therefore decided in his favor. Shortly after this, however, Sawyer committed a great fraud at the patent office, and was detected.

Further litigation over this invention, in which Edison and Maxim joined against Sawyer's claim, resulted in the invention being decided common property. Maxim draws comparison between the English and American patent systems. He says: "Under the English patent law, none could have interfered with my patent, which was ahead of all others, and was that which made incandescent electric lighting, in its original stages, a success, because it was impossible at that time to make perfect carbons without employing this process. This patent, I was informed, would have yielded me a million dollars a year, provided I had not lost it by fraud in the manner described." Maxim claims that under the American system fraud is much oftener practiced than in England, and that inventors' rights are not protected as closely in America as abroad.

Electric Elevator Service in the Postal Telegraph Building, New York.

In the Postal Telegraph building in New York city there has been in successful operation for some time a complete high speed electric elevator service of the Sprague-Pratt system, which is one of the most interesting features of that structure. The plant is the largest of the kind that has yet been installed and possesses many features of interest. When it was determined to install this equipment the problem of high speed electric elevators was in an experimental state. It is hardly necessary to say that in view of this state of affairs, which much resembled that existing when the Richmond electric railroad was first projected, the decision to depend upon electricity for the service of a building of this character was a very grave one. Failure meant a most serious blow to the finances and reputation, not alone of the inventors and engineers, but to everyone concerned in the erection and operation of the building. The requirements and guarantees were to duplicate first-class hydraulic service in speed, control, safety and capacity, to improve upon some of its characteristics, and to occupy less space. It was further promised that the cost of operation would not exceed one-half that of a corresponding hydraulic plant. In short, the issue was made in the broadest possible manner between the hydraulic and the electric elevator for the highest class of service. The plant was accepted after weeks of the severest sort of duty, with open and closed cars on freight and passenger service, carrying loads as high as 3,500 pounds, and under conditions taxing the operation of a machine to the utmost.

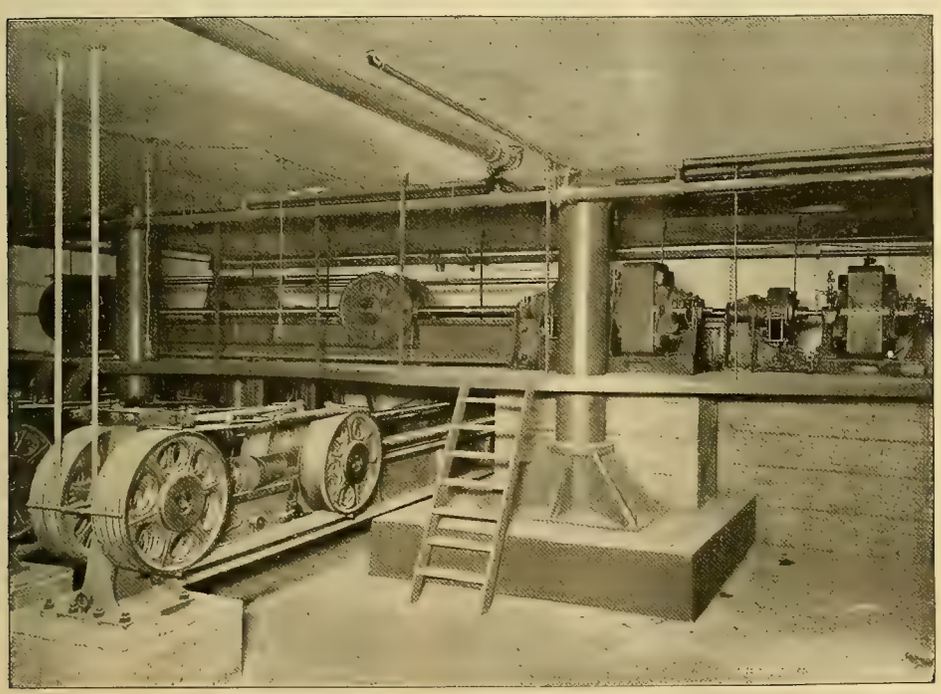


FIG. 1. ELECTRIC ELEVATOR SERVICE IN THE POSTAL TELEGRAPH BUILDING, NEW YORK.

The accompanying cuts illustrate the most interesting features of the plant. Fig. 1 is a general view of the express and part of the way machines, Fig. 2 shows the motor, moniter centrifugal, brake, thrust bearing and traveling sheaves, while in Fig. 3 the fixed sheaves of the express machines and traveling sheaves and thrust bearing of a way machine are shown. By reference to the diagram, Fig. 4, the general arrangement of the plant will be readily understood. In Fig. 5 is presented an elevation of the Sprague-Pratt electric elevator, which is the system employed. The operative nut system, which is one of the interesting features of the plant, is shown in detail in Fig. 6. The equipment was installed by the Sprague Electric Elevator company of New York.

The elevators are divided into three groups or pairs, two sets being way elevators, stopping at all floors excepting the twelfth and thirteenth, and arranged with one general frontage, a gang way in the middle and the main stairs winding around one set. The remaining set constitutes the express elevators, which stop only at and above the eleventh floor, being practically private elevators for the Postal Telegraph and Commercial Cable companies' offices, operating rooms and restaurant. This set is placed in the rear of one pair of way elevators and separated from them by the main stairs. All cars have independent platforms fitted with centrifugal governors set to be operated at 600 feet car speed by standing ropes. The way cars are a fifth larger than the express and have four hoisting and two counter-weight ropes, while the latter have two less hoisting ropes. The required loads are directly, and the speeds inversely, proportional to the floor areas, those for the way cars being 2,400 pounds live load at 325 feet and for the express cars 2,000 pounds at about 400 feet. The speeds running light are about 10 per cent. higher. These are the present normal speeds, but the motors have been found to be of so abundant capacity that the speeds can be increased to 450 feet for the way and from 575 to 600 feet for the express without difficulty or straining.

The shaft and overhead work is identically the same as in first-class hydraulic plants, and variable chain counterweights are used to make the pull equal at all points of the hoistway for any given carload. The hoisting ropes lead directly to the outboard sheaves of the hoisting machines in the sub-basement, and, dividing on either side of the crosshead, pass around the sheaves, 10 geared for the way, and 12 geared for the express, and are anchored to the head of the machines. With the exception of the control, the practice is that of the horizontal hydraulic elevator. The distinguishing feature of the electric plant is the small space occupied. On account of the peculiar disposition of the cars and position of the foundations and the party wall, six machines, two at right angles and above the others, are placed in a space about 30 feet square, with ample room for at least eight more machines, all self-contained, each perfectly independent, and with every facility of access and for renewal of any part.

Briefly described, the machine is of the horizontal multiple sheave type with a traveling crosshead and frictionless nut driven by a screw revolved by a motor directly connected and governed by a pilot motor and rheostat.

A reference to the drawing, Fig. 5, will show the general mechanical construction. This consists of a heavy main beam carrying the traveling crosshead and lower screw bearing, with special castings bolted at each end, one carrying the fixed set of sheaves and the other the thrust bearing, brake and motor. The regulating apparatus is independent and self-contained and is placed on the wall. From the car to the system of multiplying sheaves this machine and the horizontal hydraulic elevator are practically the same. The crosshead, however, marks the point or departure in the two types. In the hydraulic machine this crosshead is rigidly attached to the end of a rod terminating in a piston moving in a cylinder having an inside length equal to the lineal movement of the crosshead. This cylinder in the vertical type of hydraulics varies from 30 to 45 feet in length, with from two to eight sheave multiplications; and in the horizontal types the multiplication runs as high as 12, with corresponding diminution of length of cylinder and increase in cross-section. Whatever the gearing, however, the length of cylinder is a function of the car travel. In this electric elevator the crosshead being moved along a screw stationary so far as lineal movement is concerned, there is, with any given number of sheaves, only one variable, the length of screw, and for all heights above about 90 feet the electric machine has an advantage in matter of length, which, with increased rises becomes of great importance.

There are four features in this arrangement claiming special attention, each unique in character and marking a radical departure from all other elevator practice. These are the nut, screw and bearing, the brake, the motor and the regulating apparatus.

The hoisting nut is shown in Fig. 6. It joins the crosshead of the traveling sheaves by a conical seat. There is no fastening between the nut and the crosshead, the continual weight of the car always keeping them in contact, and the friction at this point being greater than between

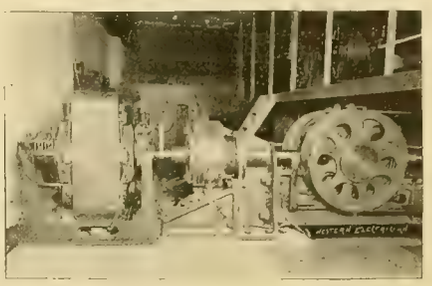


FIG. 2. ELECTRIC ELETATOR SERVICE IN THE POSTAL TELEGRAPH BUILDING, NEW YORK.

the nut and the screw enables the latter to transmit a straight line movement to the crosshead when the screw is revolved by the motor, and also to revolve the screw and drive the motor as a dynamo when the mechanical brake releases the screw to allow the car to descend. It will be seen too that the only points of contact between the nut and screw are by a chain of balls, which occupy twelve threads, and are shown entering and leaving the ends of the nut through a tube which takes the balls as they leave one end and returns them to the other end at a tangent to the line of travel between the threads of nut and screw.

So free is this machine from static friction that it is possible to start the car with a very slight increase of current over the normal hoisting current, provided time be taken, so that the work done in acceleration is small compared to the work of lifting.

The nut system is a compound one, for, beside the working ball nut, there is another, called the safety nut, keyed to it, and between the two is a powerful spring under compression.

The screw is a specially forged bar of high carbon steel with a peculiarly shaped thread. It passes through the clearance hole in the steel trunnion crosshead, which carries the traveling sheaves, then through the nut system, and is carried at the outer end by a pivoted bearing. At the inboard end it terminates in the thrust bearing, where the pressure is taken by about 220 steel balls carried in a bronze guide plate and bearing on specially hardened steel disks.

The thrust of the screw being thus taken up on the inboard end, the strain on the screw is invariably between

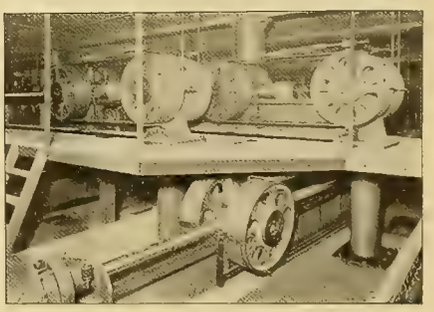


FIG. 3. ELECTRIC ELEVATOR SERVICE IN THE POSTAL TELEGRAPH BUILDING, NEW YORK.

that end and the traveling crosshead, never beyond this; hence it is always under extension strain, never under compression. Beyond the thrust plates is keyed a radially lagged iron and wooden pulley connected by a flexible coupling with the motor shaft. The function of the brake is that of locking the screw when at rest, and is not a means of varying the speed. In case of accident it has the additional function of helping to stop the screw. It may be described as a compound electro-mechanical brake. The brake band, of steel and leather lined, is anchored at one end, the hoisting side, on the motor bed frame, and the other end is continually pulled down by a powerful spring under compression. The mechanical movement in opposition is through the medium of a lever fulcrumed on a peculiar magnet casting, and having at its short arm end a universal socket connection to the divided core of a closed circuit steel

magnet. This core has a movement of one-eighth of an inch, and with the expenditure of a quarter of a horse power of electric energy has a pull of nearly three-quarters of a ton. It is operated by a dual circuit, one in hoisting, another in lowering, each possessing peculiarities in its action. In the event of failure of current for any reason, or too high a speed on the down run, this magnet releases the brake, in the latter case by a snap switch operated by a Pickering centrifugal governor driven by the main screw, and the brake-band promptly grips the brake-wheel softly, yet powerfully.

The motor is of the four-pole type, two poles being consequent, and the winding is strongly compounded. The field magnets are of a special grade of steel. The direction of current in the field coils and armature is never reversed, and the machine is never demagnetized, because in hoisting the line electromotive force predominates, while in lowering the reversed electromotive force of the motor is the only active one in the armature circuit. It should be remembered that this type of elevator is differentiated from all other electrics in that, like the hydraulics, it always works against gravity; the motor takes current from the line in hoisting, but in lowering it is cut off from the line and is operated as a driven dynamo by the falling weight of the car.

The armature is iron-clad, is of the two path special slotted drum construction, has one turn of wire to each coil, and each turn is securely imbedded in an independent insulating tube rigidly held. The carbon brushes are double, have independent movement, and ample capacity to carry the full current without flashing. The neutral point is fixed. The machine is self-oiling and the bearings are independent of the field castings.

The last individual feature of the machine to be considered is the regulator and the method of operating it.

This apparatus is an independent one and connected to the hoisting machine only by the wires necessary for the circuits. It is in brief an open cast-iron frame carrying inside a slate disk having on the lower side a row of bronze contact clips and on the other, attached to these clips and to each other by tap screws, a series of grids arranged in a circle. These grids are about nine inches long, four inches wide and three-eighths of an inch thick, and are cast in a form somewhat resembling a ribbon folded on itself. There are freely flexible when taken separately, although iron is one of the principal ingredients, and, it is claimed, the resistance averages about fifty times that of copper. The grids can stand a very high current and the temperature co efficient, while not constant, is sufficiently small as not to be objectionable.

On top of the frame is carried a ¼ horse power motor connected to the car switch through a pilot board by a cable of four insulated wires, which operates the rheostat and circuit changers. The motor is coupled to a worm gear, which carries a small pinion meshing into a spur gear on the circuit changer and controlling cylinder. This cylinder has a bevel gear driving a pinion on top of a vertical shaft, at the lower end of which is the rheostat brush arm. This brush arm carries carbon brushes which bear on the bronze clips. There are 120 of these, and the difference of potential between them is too small to allow any sparking. A quick-acting circuit breaker prevents arcing at the first clip. The operator in the car is at liberty to put the brush at any point of its travel and leave it there as long as necessary. The same rheostat is used in hoisting and lowering and the arm travels over the whole range of clips in either movement. This operation is controlled electrically either from the car or from the pilot controlling switchboard in the engine room. In hoisting, as seen from the car, the operator moves a small lever and the car starts with a perfectly accelerating speed, no jerks or pulsations being felt. Ordinarily he puts the car to full speed and makes his stop exactly at the landing with one motion of the switch. If, however, he stops a short distance below the landing floor he can raise the car that distance as in a hydraulic elevator. The operator can regulate his speed from slow to full speed, which last may be high as 600 feet per minute. A small rheostat in the field of the hoisting motor gives a fixed adjustment of about 10 per cent. variation in the maximum speed of the car. If the operator forgets or is unable to operate his switch to stop the car, there are two automatic stops which will only allow it to go a few feet above the top floor.

The moving of the switch to "up" puts current through the up coil of the pilot motor, which, moving the regulator, connects the main motor to line, sends current through the armature and a progressively reduced resistance, the current releasing the brake and increasing the torque until the armature begins to turn without shock or jar, and thus

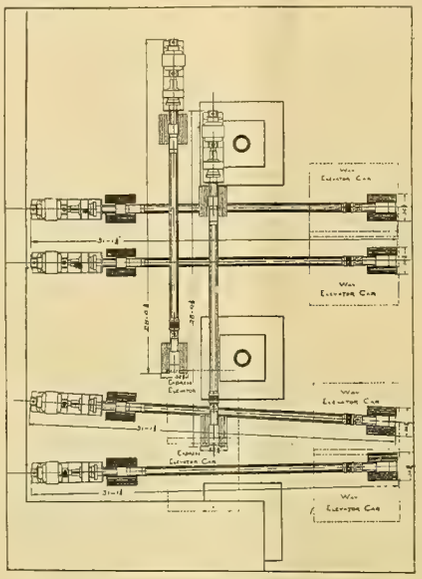


FIG. 4. ELECTRIC ELEVATOR SERVICE IN THE POSTAL TELEGRAPH BUILDING, NEW YORK.

accelerates the car in a perfectly timed progression. A return of the switch to "steady" instantly arrests the movement of the rheostat arm, checks the pilot motor by an automatic brake and stops the acceleration of car speed. A return to "stop" cuts off the current gradually, but more promptly than the reverse movement. In lowering, the rheostat brush closes circuit on the zero resistance clip, and at the same time closes a circuit through a shunt coil on the brake magnet, releasing the brake. The motor now becomes a separately excited compound dynamo with the weight of the car to drive it. Hand control can be substituted for the pilot motor control.

There is no effort of the motor exerted to aid the car in lowering. The friction for the weight of the car to overcome in order to start this dynamo load consists of that of the car guides, overhead sheaves, multiplying sheaves, the crosshead guide, the ball bearing nut, the thrust bearing of the screw, and all the screw and armature bearings. The fact that 500 pounds on the hoisting ropes will overcome this and start the motor instantly, is due to the use of rolling friction on all sheaves, the nut and the screw thrust bearing.

It is impossible to attain a rapid acceleration of speed on the start down, for at the first position of the rheostat brush the torsional resistance of the armature will not allow the full car load to drive it above 5 per cent. of its normal speed, and from there to the highest resistance there are 120 variations of speed up to the maximum.

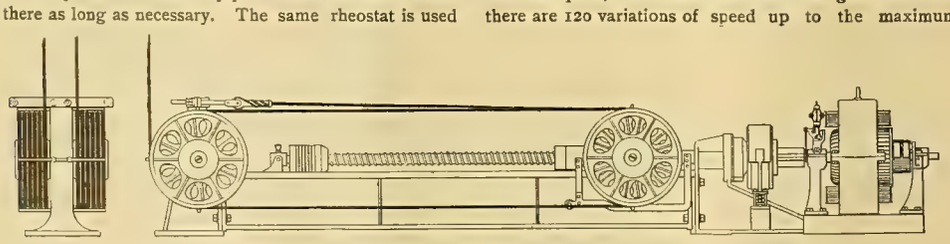


FIG. 5. ELECTRIC ELEVATOR SERVICE IN THE POSTAL TELEGRAPH BUILDING, NEW YORK.

Aside from this, the mechanical conditions of starting a screw to revolve by pressure on the nut from a limited force when the pitch is slight and the inertia of the armature is considerable, renders a sudden start impossible and insures an even acceleration of speed independent of the dynamo action.

When the car is within about six feet of the lower landing a roll on the traveling sheaves engages a lever that reduces the resistance in a by-path in the armature circuit and brings the car to an easy stop at the landing independent of the operator.

Besides the control from the car there is provided in the basement a unique general controlling switchboard by means of which the control can be taken from the switch in any car and transferred to the switch on this board. In this way general inspection, cleaning, testing, or if needed, replacement of any part of the regulator or machine, whether in the ordinary course of affairs, or in case of accident, the hoisting of safes, all can be carried on from below without an operator in the car; in fact, even while in motion the control can be instantly taken from the operator and the car run from the pilot board.

The care and attention required by an elevator of this type as compared with the hydraulic plant is in its favor, for aside from the ball bearing nut there are no more parts to attend to and renew than there are in an ordinary electric elevator. The thread of the nut is hardened by a special process that renders it for a depth of one quarter of an inch as hard as steel can possibly be made. The thread is afterward ground true and smooth. Tubes are then inserted to circulate the balls from one end to the other. The balls are one-half inch in diameter and of standard make. The load per ball is not over 100 pounds maximum. One of these nuts has run for 24 hours a day for 16 months, and was only removed twice in that time for inspection. The operating nuts of the Postal Telegraph plant, although at times under vicious duty, show no wear of the working thread.

As illustrating the facility of access, a car can be slung by its ropes from below, the end screw bearing, the buffer nut, the working nut all removed, the balls taken out and inspected, the nut cleaned, and the whole restored and car put into operation again within thirty minutes. The balls in the nut can be inspected while the machine is in operation. The multiplying sheaves run on bearings which show no wear at all and do not require oiling or cleaning more than once a year. Not a drop of oil runs out of them. Hydraulic engineers will appreciate this, and also the fact that any or all sheaves on this elevator can be removed without disturbing any other part of the machine. There are four nests of sheaves on this elevator and any nest can be exchanged for a spare nest within five minutes after the ropes are slacked. It would take five hours to do this on a hydraulic elevator, as it would be necessary to nearly dismantle the whole machine to get at them. This machine can be absolutely dismantled and practically every working part laid on the floor in an hour and a half.

The next feature is the vitally important element of safeties: First, the screw, which is a bar of special forged steel under tension and torsion strains, and capable

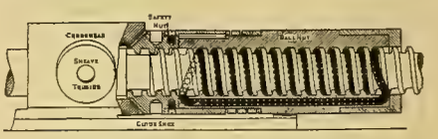


FIG. 6. ELECTRIC ELEVATOR SERVICE IN THE POSTAL TELEGRAPH BUILDING, NEW YORK.

of sustaining twenty times the heaviest load applied to it; secondly, the hoisting nut, which is of special steel, hardened and finished by a special process, and has shown almost no wear whatever in a year's severe run under conditions particularly onerous. In addition to this is a safety nut. This nut is normally out of contact with the screw's thread; it is secured to the hoisting nut, and should any accident happen to the latter which would break its hold on the screw's thread, this safety nut, the thread of which interlocks with the screw's thread to a greater denth than the thread of the hoisting nut, would then take the place of the hoisting nut and form an anchorage to hold the traveling sheaves with a grip exceeding the strength of the screw. There is another safety in the nut system, however, warranting special mention. The hoisting nut is only held from revolving by its friction against the crosshead; when the nut gets to the upper limit of its travel the safety nut meets a solid collar on the screw which stops its travel and causes it and the ball bearing nut to revolve with the screw, thus stopping the travel of the nut absolutely without stopping the motor, and allowing the traveling sheaves to be stopped simply by the weight of the car. This stop has been made at full speed without any injury whatever. Of course this never works when the upper limit switch is in proper order, and there is nothing about this last to get out of order. Another important function performed by the hoisting nut in a very simple and direct way is its action as a slack cable device. The car, descending at high speed and driving the nut along the screw, revolving the screw and armature thereby, meets an obstruction, the pressure against the nut is reduced to only that given by the weight and sag of the ropes, and the working nut recedes slightly, which allows the spiral spring between the safety and ball bearing nuts to extend and force the safety nut against the back of the screw's

thread. The friction then between the nuts and the screw is greater than between the safety nut and the crosshead, therefore the hoisting nut at once revolves with the screw, its travel along the screw ceases, and it checks the traveling sheaves before the cables are really slack. This action has been tested with a car stopped by its centrifugals when going at 600 feet per minute.

It is moreover evident that if the screw should become free to revolve unchecked by motor or brake—an improbable conception under normal conditions—the weight of the car would not cause the screw to revolve at a speed at all comparable to a free fall. In any event there remains the rubber buffer at the lower end of the screw to cushion the end of such a run. The use of the buffer as well as the frictionless character of the nut has been most effectively

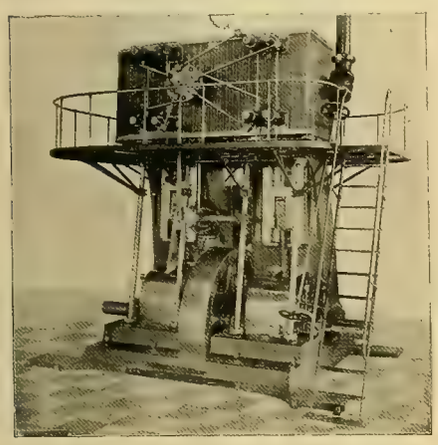


FIG. 1. NEW BALL & WOOD VERTICAL COMPOND ENGINE.

illustrated by actual drops from heights up to the twelfth story. This buffer nut can stop a car going at a speed of 800 feet per minute in 18 inches without starting a bolt or fastening. The rope fasteners used on this elevator consist of a solid body of metal which has a double spiral groove; the ropes enter this groove by being passed through a loop in one end, wound twice in one groove, passed through a loop in the other end, returned in the other groove in spiral convolutions between the first winding and out through the loop in the first end. This engages about three feet of the rope, instead of about three inches, which other rope fasteners hold. Tested in Fairbank's testing scales, it took 10,500 pounds to break a five-eighths inch iron wire rope, which gives this rope a higher rating than quoted by the makers in their catalogues. The engineer in charge of these scales stated that other rope fasteners usually break the rope at from one-half to three-fourths of the rated strength.

Besides the lower limit switch already described there is an upper limit switch for cutting off the current. This is a double operating and self-cleaning lock snap switch, moved by a roll on the crosshead, and cuts off the current in hoisting at the upper limit, allowing the brake to come on. On the reverse movement the circuit is closed for hoisting.

In the matter of economy this electric elevator has scored an important victory over the hydraulic, for while buying current from the street system at the rate of five

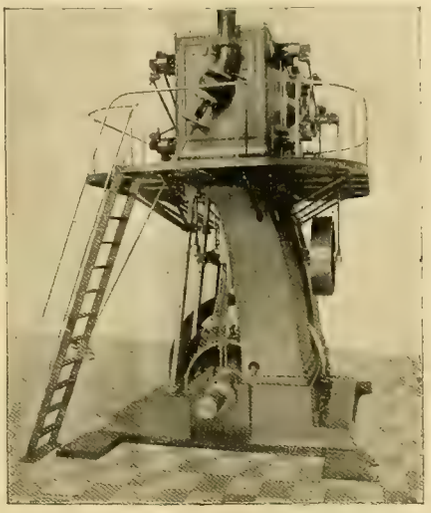


FIG. 2. NEW BALL & WOOD VERTICAL COMPOUND ENGINE.

cents per horse power hour, reckoned on an 850 watt rate, pending the operation of the local plant, the cars are being operated at a cost not exceeding three-fifths of a cent per round trip of 26 floors, which is not over 40 per cent. of the cost of operating a like hydraulic system, even with an independent plant. The reasons ascribed for this difference are that the standard hydraulic elevator, as now operated, is supplied at a practically constant pressure by a compression tank automatically regulated in the basement or a roof tank which may be also a compression tank. Whatever the load, identically the same amount of water at the same pressure is used for every foot of travel, and consequently no matter how light the car may be running it always uses the maximum power. Statistics show that the average live load on a passenger car is not over one-fifth the maximum which it can carry.

Including the counter-weight, which in a high speed hydraulic elevator is, on account of the friction, fully 400 pounds lighter than in an electric elevator of equal capacity, on account of the difference of friction, the total average load is about a third of the maximum.

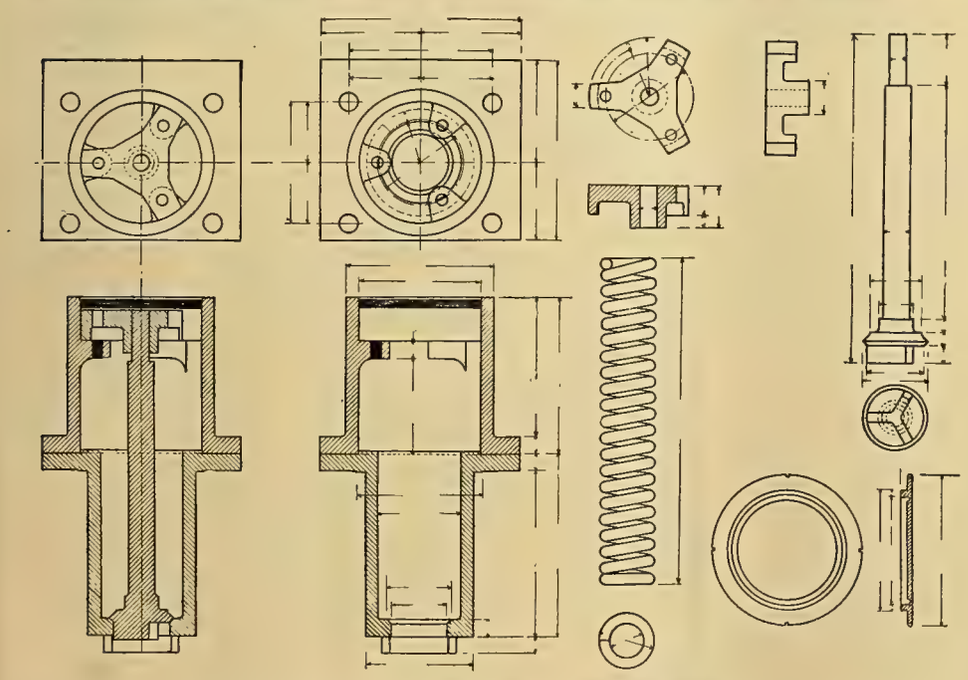


FIG. 3. NEW BALL & WOOD VERTICAL COMPOUND ENGINE.

For an example, take a car of 30 feet floor space. This can be loaded up to about 100 pounds per square foot or 3,000 live load, while the average live load will not be over 600 pounds. In a hydraulic elevator it would take about 900 pounds excess of weight in car over the counterbalance to insure proper running. This means a load of 3,900 pounds on the ropes; but this is not all. Since the speed of the car with any given opening of the valve is a function of the difference in pressure in the supply and the cylinder, and since there must be an excess of pressure on the supply side in order to have the car move at all, then to move this total load of 3,900 pounds at even a low speed there must be a capacity to actually lift about 500 pounds more than this, or 4,400 pounds, yet the average load on the ropes is only 1 500 pounds.

In a Sprague-Pratt electric elevator such a car be operated with 600 pounds excess of weight, making an average load on the hoisting ropes of 1,200 pounds, and since this elevator uses power very nearly in proportion to the load over friction there would be as between the two classes of elevators a constant duty on the hoisting ropes of the hydraulic of 4 400 pounds, and on the electric of 1,200. Without going into exact statements, the friction of the electric machine is quite as low, if not lower, than that of the hydraulic, because one is on ball bearings, and the other has a tightly packed gland and piston. The best pumps in common use require 70 to 85 pounds of water per horse power delivered to the water column, whereas electric power can be delivered to the mains of the motor for an expenditure of about 35 pounds of water.

It was well known before this elevator plant was started that the economy indicated would be shown, but it has been some satisfaction to have it demonstrated in so emphatic a manner by a long period of operation.

New Ball & Wood Vertical Compound Engine.

The advent of dynamos arranged to be placed directly upon the engine shaft greatly emphasized the need of a high speed engine possessing the requirements of higher rotation, less floor space and better regulation because of the great saving in cost of dynamos when higher relative speeds are employed, and the desirability, also, of close regulation. With increased rotative speed shorter stroke is permissible, and hence the vertical form of engine, with its points of merit, offers fewer disadvantages than when extremely long strokes are used. The engine illustrated in Figs. 1 and 2 is the latest product of the Ball & Wood company, and is worthy of extended notice. It is designed for the Chicago Edison company's station at Wabash avenue and twenty-seventh street, and is intended to drive a dynamo upon each end of its shaft. It is of the compound non-condensing type, with cylinder dimensions of 19 by 31 by 24 inches, and an internal steam pressure of 125 pounds. It runs at 150 revolutions a minute. In Figs. 3 and 4 may be noted the design of the machine. Its chief characteristics are unexcelled economy, obtained by minimum clearance spaces, and correct distribution of steam, moderately high rotative speed, accurate regulation, a cut-off valve gear giving rapid cut-off and wide opening of ports at all points from zero to three-quarter stroke, small floor space, special adaptation to driving direct-connected dynamos, by reason of the shaft being entirely unencumbered with valve gear at both ends outside of the pillow blocks, desirability for mill work, in the combination of economy and regulation.

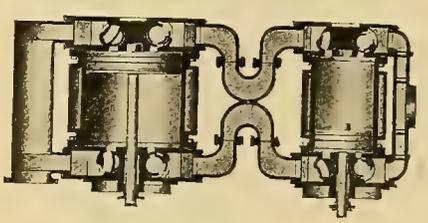


FIG. 4. NEW BALL & WOOD VERTICAL COMPOUND ENGINE.

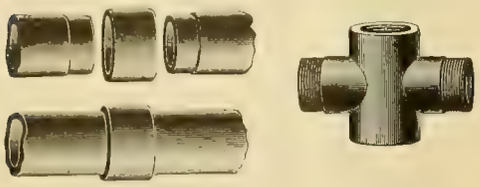
The location of the valves in the cylinder head, giving as it does the shortest possible ports, permits of their being of ample capacity without an appreciable increase of clearance. The peculiar motion of the cut-off valve utilizes these wide ports to the fullest possible extent, and the cut-off motion at every point from zero to three-quarter stroke is a rapid one; in fact, as rapid as is obtained from the releasing gear, because of the higher rotative speed of the engine. Another feature of great importance in this gear, particularly with compound engines, or where moments of excessive overload occur, is its ability to cut off at three-quarter stroke.

In appearance, as may be seen from the accompanying illustrations, this machine is entitled to the first rank, and as an example of a type is highly creditable to the Ball & Wood company.

The Eastern Extension Telegraph company has just agreed to connect Borneo with Labuan by a branch cable, and the directors of the British North Borneo company have decided to connect Sandakan, the capital of their territory, by telegraph and road across country, a distance of 200 miles. The work will be completed within a few months.

Fiber Conduit.

The Fiber Conduit company, New York, has lately constructed a mill at Orangeburg, N. Y., built with all modern appliances and run by electric power, which gives the company every opportunity of turning out the conduit fittings shown in the accompanying illustration. This fiber conduit is intended for underground electrical purposes, and it is claimed that, being a perfect insulator and entirely unaffected by electric currents, it is a satisfactory solution of the problem of electrolytic action which has been attracting so much attention in Boston, Milwaukee, Brooklyn and



FIBER CONDUIT.

other of the larger cities. The conduit is made of wood fiber, treated with an insulating and preserving compound, which produces a hard and solid substance.

The finished pipe, in five foot lengths, is uniform in thickness, with smooth surfaces, and is made in a number of standard sizes, with the necessary regulation fittings, section boxes, etc. Two standard joints are made, one a socket and the other a screw joint, and also, when required, a special socket joint which is wholly in the pipe, thus not increasing the outside diameter. The weight of the finished product is less than one-third that of iron pipe of the same size. It is claimed that the conduit is practically imperishable when laid in the ground. As it is non-absorbent, it is not affected by acids or alkalies and does not contract or expand with varying temperature; it is, therefore, free from the splitting and checking, corrosion and disintegration which injure wood and iron.

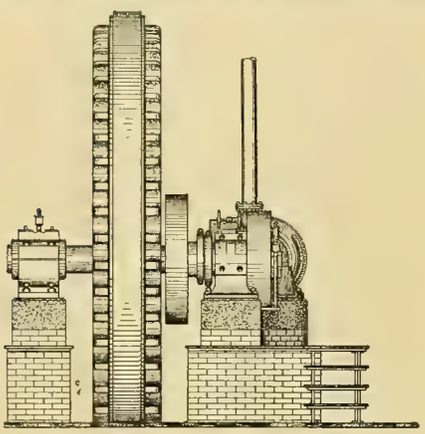
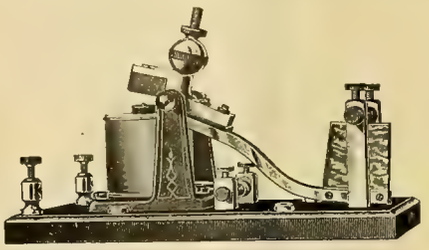


FIG. 2. WARREN ENGINE-DYNAMO.

The material is tough, elastic and strong. Standard three-inch pipe will safely bear a crushing weight between two plane surfaces of 800 pounds per lineal foot, and it will stand a pressure of 450 pounds at the center of a five-foot length supported at both ends. Its bursting strength is over 125 pounds per square inch. As to insulation, it is said that conduits seven-sixteenths of an inch thick have been tested on a 20,000 volt alternating current without any perceptible effect. Moisture does not condense on the surface, as in metal pipes, and it is claimed that bare copper can be used in the conduit to great advantage and with any working voltage. It is easily cut with ordinary tools, and joints, fittings, etc., may be introduced at any point.

Doane Lightning Arrester.

In the accompanying illustration is shown the Doane lightning arrester with binding post for general use which differs from existing forms of apparatus designed for the same purpose. In this form of arrester the short circuit is made through a non-inductive resistance sufficient to limit the current that will follow the lightning discharge to an amount that cannot do any injury. With a non-inductive resistance of 100 ohms in series with the arc



DOANE LIGHTNING ARRESTER.

only five amperes can follow the discharge. This can do no harm and the arc formed is easily extinguished. No current passes through any movable part of the arrester and with only a limited current through the carbons they are practically indestructible.

The few parts and durable construction of this lightning arrester will commend it to the trade. It is manufactured by the W. S. Hill Electric company, Boston.

Bryant Double Pole Switch.

The Bryant Electric company of Bridgeport, Conn., has recently placed upon the market a double pole switch,

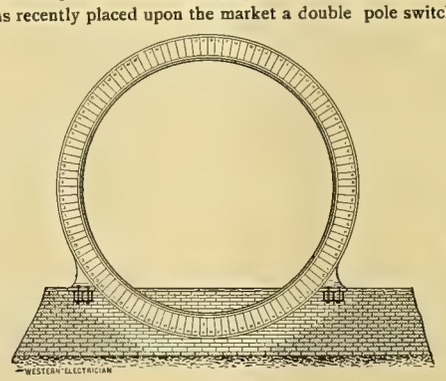
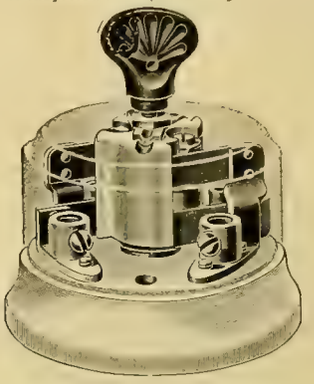


FIG. 3. WARREN ENGINE-DYNAMO.

which in size is but a little larger than the single pole switch. An illustration of the switch is herewith presented. The switch has a nickel cap and porcelain base; the mechanism is positive in its action and the material and workmanship is good. The Bryant Electric company's reputation for turning out the best grade of specialties makes its name, when attached to any new specialty, equivalent to a guarantee of its worth. The western office, in the Monadnock building, Chicago, is in charge of Thos. G. Grier and Edward R. Grier, and a complete stock of the Bryant goods is kept on hand at the office.

New Metallic Shade and Stand.

In the accompanying illustration is shown a new metallic shade and stand which is being introduced to the electrical trade by the patentee and manufacturer, E. D. Cooke, of the Unity building, Chicago. Many metallic shades have been introduced and for a time have given excellent satisfaction, but sooner or later something in the way of an improvement has appeared, and shade after shade has dropped out of the market to make room for one apparently of more simple adjustment, of better design and with more points claimed for concentration of light, etc. The Cooke shade is possessed of many points of material improvement. It can be constructed of any metal desired. At present it is being made from a very fine quality of brass, extremely thin and nearly if not quite as light as aluminum. The shade is subjected to a special lacquer treatment, which



BRYANT DOUBLE POLE SWITCH.

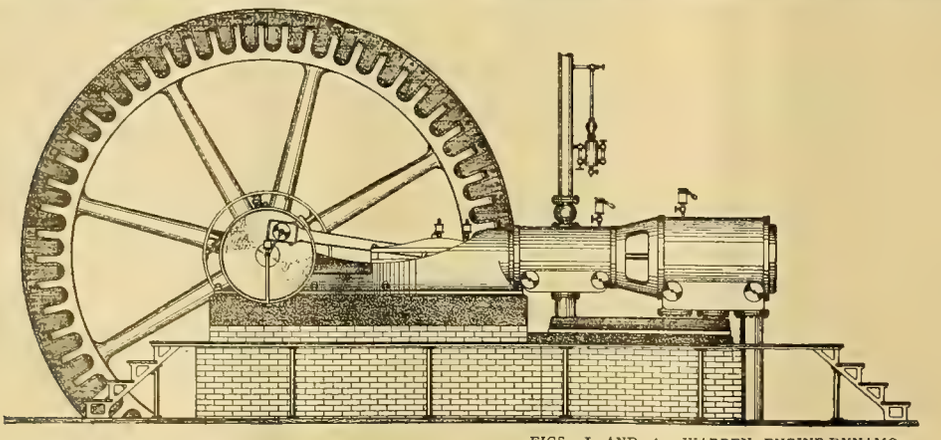
prevents all possibility of its tarnishing. The feature of its adjustment merits special attention, and is in reality the most particular point of value in the shade, avoiding entirely the necessity of either rim or collar. The upper and lower spring fingers fit themselves snugly to the socket, and adjust themselves instantly to any standard socket without the wasting of a moment in getting them to conform to any make. In calling attention to the stand it

NEW METALLIC SHADE AND STAND.

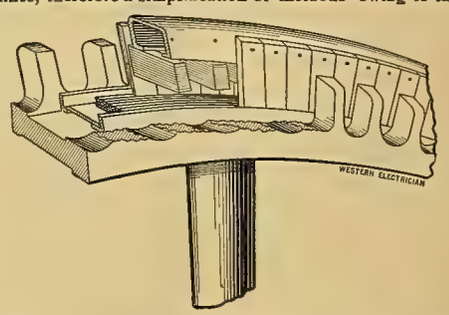
may be said that it is portable in every sense of the word, every part of it being susceptable to an adjustment of some sort. It can be raised or lowered and adjusted to any angle desired by the simple loosening or setting of a single set screw. The loosening of this set screw also allows the lamp arm to be drawn out at full length. The stand is made with an attractive cast and polished copper base with handsome polished brass arms. It may be well to add that this stand requires no wiring whatever, but can be moved anywhere and with the spring collar attachment any drop light may be made use of instantly for desk or table. A descriptive illustrated folder has been issued, and will be mailed upon application.

Warren Engine-dynamo.

The combination of a prime mover and electric generator as illustrated in the desigs of the Warren engine-dynamo means a single machine in the place of two separate machines, therefore a simplification of methods owing to the absence of shafting, belts or gearing. It also means a more economical mechanism by overcoming the losses inherent to the transmission of power through intermediate devices and an installation occupying a minimum of floor space. The engine-dynamo, as illustrated



FIGS. 1 AND 4. WARREN ENGINE-DYNAMO.



in Fig. 1, which shows a tandem compound engine designed to revolve at 134 revolutions a minute, is built by utilizing the engine fly-wheel for the field core and pole pieces of the dynamo. The machine illustrated is of sufficient capacity to operate the fly-wheel, around which is built a 200 kilowatt alternator, capable of operating 4,000 fifty-watt incandescent lamps, exclusive of line and transformer loss. The entire space required for this plant, exclusive of boiler room, is 15 by 35 feet, allowing ample space all about it. An 8,000 light plant with compound engine will be liberally accommodated with room in a space 25 by 35 feet. If a vertical engine be used, the actual floor space required will be reduced still more.

Inasmuch as no mechanical device for obtaining motion is required other than one to revolve the magnet core and pole pieces, and the engine fly-wheel itself becoming the field core, or magnetic part of the machine, it is obvious that to complete an engine-dynamo there must be provided a magnet coil circuit closer and induction coils, which is done by attaching them to an iron ring that surrounds the fly-wheel, Fig. 3, and remains stationary. Nothing revolves but the iron of the fly-wheel. There is no

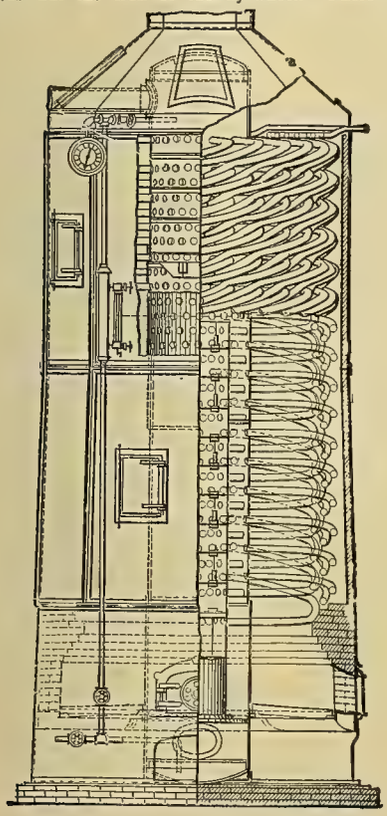


FIG. 1. MORRIN CLIMAX STEAM GENERATOR.

commutator, collector rings, brushes, or any current-carrying part whatever that is in motion. A vertical section is shown in Fig. 2. With the engine-dynamo a duplication of iron that may be put to magnetic use is avoided, and the power lost in transmission through belts, counter-shafting, etc., is saved. This combination is adapted to any voltage and may be changed from high to low voltage, or vice versa, by simply changing the inductor coil connections, no new part or piece being required in making such a change. It may be used as an alternating current arc lighting machine, or its circuits may be divided and arc lights operated on a portion of them and incandescent on the remainder. A good idea of the mechanical and electrical construction of the machine may be gained by reference to Fig. 4, where the different parts are assembled. This machine has been designed and is being exploited by the C. C. Warren Electric company, Chicago.

Morrin Climax Steam Generator.

The increasing demand in stations where the ground space is necessarily limited for boilors that will develop a maximum amount of power and at the same time take up very little room has led to the use of water-tube boilers to a considerable extent. This form of boiler has the advantage of occupying the smallest possible space, and beside its safety from explosion has great durability, and may be repaired when necessary with a minimum loss of time by stoppage. In Fig. 1 is shown a vertical section of the Morrin steam generator as manufactured by the Clonbrock Steam Boiler Works of Brooklyn, N. Y. A cross-section is represented in Fig. 2. The heating surface of this generator is made up of loops of steel, which are expanded into the cylindrical shell. Within the shell is a second cylinder, which is not necessarily steam and water-tight, and is bolted together in short sections for convenience of removal in case of repairs being required. The cylinder is closed at the bottom and at a point at the top, which is a little below the water level. The lower end of each of the tubes is connected to the inner cylinder by means of short tubes. These short tubes are not expanded, as it is not necessary that they be kept tight. The purpose of this arrangement is to secure a constant, rapid circulation within the main tubes, which result it accomplishes perfectly. The firebox surrounds the cylinder, and the products of combustion impinge upon all of the tubes in succession. The grate may be either stationary, in which case more than one fire door is required, or rotary, when one fire door is sufficient. With a mechanically driven, rotary grate an automatic feed mechanism may be successfully used. This type of boiler is used at the Chicago Edison station at Wabash avenue and twenty-seventh street, where furnishes steam for the Ball & Wood engines.

Telephone Service between Chicago and Washington.

Postmaster Hesing of Chicago carried on a conversation with Washington postoffice department officials on April 12th. The occasion marked the opening of the Chicago postoffice telephone system, and the test was of a successful character. It was anticipated that President Cleveland would be at the Washington end of the line, but it was found that there was no long-distance instrument in the White House. Mr. Hesing, however, talked with First Assistant Postmaster-general Jones, and conversation was carried on between different gentlemen in the two cities. Postmaster Hesing expressed himself as much pleased with his new system. There are 22 instruments in the new postoffice circuit, one in the office of each department chief and the rest scattered among the sub-stations. There is a private exchange for these in Room 5 of the government building, and postoffice officials can transact business now with their fellows in any part of the city without the delays incident upon the use of the general exchange. Any of the instruments can be cut into the public exchange or the long, distance system at will.

Death of Leverett L. Leggett.

Leverett L. Leggett, the patent lawyer who drew up most of the Brush patents over which there has been so much litigation, died of apoplexy, Monday, April 9th, at Sandusky, O. Mr. Leggett was about 48 years of age and was a gentleman of such accomplishments and versatility that he gained the sincere respect and admiration of his friends. He was the son of General M. D. Leggett, who was at one time commissioner of patents at Washington and was associated with him for a period in the law firm of Leggett & Leggett. As stated Mr. Leggett was the patent attorney of C. F. Brush, and some famous patents, among which may be mentioned the Brush patents on secondary batteries, on compound wound dynamos and the celebrated arc light patent 219,208, were drawn up by him. To him is credited the coining of the word "dissimultaneously," which has been the cause of much argument in the courts. Although a lawyer of recognized ability, Mr. Leggett paid considerable attention to the study of medicine and was graduated as a regular practicing physician. A brother, Wells Leggett, who died several years ago in Detroit, was also a member of the legal profession, and was made prominent by his association with the Brush patents.

General Electric Directors.

The annual meeting of the stockholders of the General Electric company was held in Schenectady, April 10th. The entire body of directors was elected. The board is composed of Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., C. H. Coster, Thomas A. Edison, Eugene Griffin, F. S. Hastings, Henry L. Higginson, D. O. Mills, J. Pierpont Morgan and H. McK. Twombly. It was voted to increase the board of directors from eleven to thirteen members, and the two vacancies thus formed will be filled by the board at a meeting to be held soon, at which time the officers of the board will also be elected. The date of the annual meeting was changed from the second Tuesday in April to the second Tuesday in May.

Thomson Recording Wattmeter for Arc Circuits.

In the article published in the issue of March 24th descriptive of the Thomson recording wattmeter for arc circuits it was stated that the safety cut-out "is designed to close immediately on possible trouble occurring within the meter." This should have read: "The cut-out is designed to close in case of any trouble on the circuit which the meter is measuring. On closing, this device cuts out both the meter and the lamps upon it and serves not only as a protection to the meter, but to the lamps which it is measuring. A rise in potential around the lamps which are being measured sufficient to cause trouble will throw this cut-out into action and absolutely preclude any danger to the meter or its circuit."

CORRESPONDENCE.

New York Notes.

NEW YORK, April 16.—Mayor Gilroy has placed himself on record as decidedly and unalterably opposed to the rapid transit bills which have been introduced into the Legislature. Lieutenant-governor Sheehan presented a communication from the mayor in the Senate on April 10th, in which he said:

The point that I regard as absolutely fatal to the proposition to build a rapid transit road with public money, either expended directly or loaned to a construction company, is found in the constitutional provision limiting the bonded indebtedness of a city to 10 per cent. of its assessable real estate valuation. The assessed valuation of the taxable real estate of the city of New York in 1893 was $1,562,502,393; the net indebtedness of the city on December 31, 1893, was $100,762,407.51. This shows a margin of less than $50,000,000 between the net indebtedness of the city and the constitutional limit. The Chamber of Commerce rapid transit bill provides at once for an expenditure of $50,000,000.

The position taken by Mayor Gilroy is not a popular one, and his communication has been made the subject of some severe criticism. It is declared that he does not represent the majority of taxpayers.

An interesting conference was held last Saturday under the auspices of the Chamber of Commerce. Representatives of the various interests in the matter of rapid

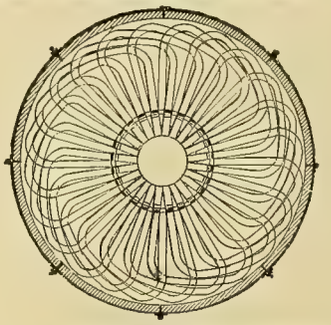


FIG. 2. MORRIN CLIMAX STEAM GENERATOR

transit were invited to meet Senator Lexow and discuss with him the situation. It was agreed to take immediate steps toward securing the withdrawal of the Lexow-Butts bill. If this is done the rapid transit committee of the Chamber of Commerce will agree to eliminate from its bill the names of the proposed commissioners, allowing the governor of the state to make the necessary appointments. Although it is regarded as such, the old rapid transit commission is not dead, for announcement is made that a brand-new and particularly mysterious syndicate wishes to confer with that body regarding the construction of an underground road. All the commissioners, Mr Steinway is credited with saying, are convinced of the financial responsibility of the syndicate and are disposed to begin negotiations. The prospect that the commission may be legislated out of office should the Chamber of Commerce bill become a law deters the commission from applying itself industriously to any new scheme, according to Mr. Steinway, although, should the bill not be passed in a week or two, the Bushe plan for a so-called independent elevated system may be formally adopted. Mr. Steinway has, however, expressed himself as strongly in favor of the Chamber of Commerce plan and opposed to any elevated road or extension of the present system as a makeshift.

A bill introduced by Senator Pound, incorporating the Niagara Tramway company, whose object is to run a line of observation cars suspended from a cable fifty feet above the Niagara river, following the crest of the Canadian and American Falls, has passed the Senate and promises to become a law. The cable will be two inches thick, capable of supporting fifteen tons. The cars will be almost entirely of glass and iron. They will be operated by electricity. The organizers of the company are George W. Pound, ex-Senator John E. Pound, ex-Senator F. E. Ellsworth, Postmaster John A. Merritt of Lockport, R. N. Campbell of Niagara Falls, A Raymond of Welland, Ont., J. B. Cutter of New York, and other capitalists.

The Central New Jersey Traction company has been incorporated with a capital stock of $150,000. As its purpose is to carry out Joseph H. Reall's scheme to connect New York and Philadelphia by trolley, the capital

stock will be greatly increased. A supplementary charter is now being obtained in Pennsylvania for a line from Philadelphia to Trenton. It is said that construction between Paterson and Orange and Trenton and Kingston will be begun at an early date. W. F. O.

PERSONAL.

Frederick A. La Roche, president of the La Roche Electrical Works, was in Chicago this week on a business trip.

William H. Hornberger and E. Kuhlman, of the Hornberger Electrical Manufacturing company, Elkhart, Ind., spent a few days in Chicago this week.

W. D. Packard, of the New York & Ohio company, Warren, O., manufacturerer of the Packard incandescent lamp, visited a number of Chicago electrical firms this week.

Prof. T. C. Mendenhall made a report on the International Electrical Congress at Chicago, before the American Meteorological Society, at its annual meeting in Washington, April 20th.

James I. Ayer of St. Louis has taken the position of general manager of the Royal Arc Light company of New York. Mr. Ayer's popularity in electrical circles warrants the prediction of his success in this capacity.

MISCELLANEOUS.

The contract for electrical work ordered let to Altman & Samms by the county board, Chicago, April 9th, has been ordered canceled and a new set of bids has been advertised for by the board. When the bids were received that of Altman & Samms was not accompanied by a certified check of 10 per cent. of the contract price and it was ordered rejected. The other bids were sent to the superintendent of public service for tabulation. In some manner the bid of Altman & Samms was sent with others and it appeared in the tabulated list as the lowest bid.

William H. Merrill, Jr., chairman of the committee on fires of the Underwriters' International Electric association, has issued his third report of fires caused by electricity. He enumerates 82 fires tracable to electricity and involving a loss of $940,000. Crossed wires, bursting incandescent lamps through sudden increase of voltage, crossing of flexible cords, crossing trolley wires, grounding of arc circuits on cornices, burn-outs, short-circuiting and bad insulation are among the leading causes. The report is accompanied with illustrations of wires and apparatus that have burned out.

TRADE NEWS.

The Fuel Economizer company of Matteawan, N. Y., sole maker in the United States of Green's improved patent economizer for steam boilers, has closed a contract with the Toronto, Oat., Street Railway company for 3,000 horse power of economizers.

The Turner Brass Works, Chicago, manufacturers of electric brass fittings and dealers in miscellaneous brass work, have just moved their offices into the building adjoining their factory, 122 Kinzie street. The increasing demand for the popular articles which this firm manufactures, has made this change necessary.

Cushing & Morse, general western agents for Kerite wire and cables, 225 Dearborn street, Chicago, have achieved such a reputation for the distribution of novel little reminders of the merits of their product, that any little package marked "Cushing & Morse" is opened with the anticipation of something pleasing. The latest from this firm is an envelope containing a quantity of sticking plaster, which, in consideration of April's recent cutting weather, is most appropriate. Kerite must be possessed of wonderful properties, for on the package is written among other recommendations "To cure profanity use Kerite."

A catalogue of 452 pages is a pretty high standard for an electric supply company to set, but the Metropolitan Electric company, 186–188 Fifth avenue, Chicago, which has just issued its first annual catalogue, has found it necessary to compile such a book in order to make mention of all of its specialties and the line of goods which it is handling. The book is neatly bound, is possessed of a striking cover and is exceptionally well illustrated. In the preface the Metropolitan company states that it feels in presenting its first catalogue to the trade it should not be criticized too severely; its aim has been to prepare something for the ready use of its customers in identifying its goods and to give some general idea of the scope of its business. There is no doubt that it has succeeded admirably and that any apology is entirely unnecessary. The Metropolitan Electric company has built up an extensive business in a space of time which reflects much credit upon its officers and it is to be congratulated upon its ability to produce a catalogue so indicative of prosperity. Within its pages may be obtained many valuable hints and ideas regarding the purchase of telegraph, telephone, electric light, electric power, electric railway and electric house goods supplies and, in fact, regarding everything pertaining to the electrical supply business. The company has been made the general western agent for a number of prominent manufacturing firms, and these agencies have been selected with great care. These specialties are naturally given considerable prominence. Among them the P. & B. products and N. I. R. wire attract attention. The Metropolitan incandescent lamp, Paiste's Xntric switches, Mac tape and many others are given their due share of attention. The reading matter is well arranged and is fully descriptive of the articles illustrated. On the back of the book is the key to an elaborate system of ordering and communicating with the company by code as well as a number of useful tables for use in computation. It is hard to see how a more complete or more satisfactory catalogue and price list could be compiled than that of the Metropolitan Electric company, and its appearance is certainly very creditable to the company. It is the intention of the company to give the book a very extensive circulation, and it will be mailed to the trade on application.

BUSINESS.

H. McL. Harding of the Walker Manufacturing company has been in Chicago looking after the interests of the company following the death of J. L. Barclay.

Finney & Modisette, 811 New York Life building, Minneapolis, Minn,, have opened an office for the purpose of transacting a general electrical contracting business, and have been appointed agents of the Fort Wayne Electric company, Fort Wayne, Ind. The new firm starts upon its business career with every prospect of success.

J. Jones & Son, 39 Vesey street, New York, have bought from the receiver of Alexander, Barney & Chapin, the balance of the stock remaining on his hands at 67 Cortlandt street. J. Jones & Son propose to move into the firm's former store, and that this may be done as soon as possible it offers the trade some particular inducements in electrical goods.

W. B. Southgate & Co. have opened an office at 146 Franklin street, Boston, for the sale of an extensive line of electrical goods, acting as manufacturers' agents. Mr. Southgate has been for a number of years prominently connected with the Whitney Electrical Instrument company of Boston and has a large acquaintance who will be pleased to hear of his new venture

The Western Electric company, Chicago, is now manufacturing a new line of slow-speed multipolar motors with iron-clad or surface-wound armatures of all sizes from one-half horse power up to any desired size. These motors are particularly noted for efficiency and durability. Motors of the multi-bipolar type are manufactured in sizes of two, five and ten horse power, and the ordinary two-pole high speed type from two horse power up to any desired capacity.

The laundry, kitchen, engine and boiler rooms for the Green Island Improvement company's new hotel at Lake George, N. Y., will be built of iron. The work is to be furnished by the Berlin Iron Bridge company of East Berlin, Conn. The Delaware, Lackawanna & Western Railroad company has placed the order for two engine house roofs with the company. Both roofs will be covered with the Berlin Iron Bridge company's patent anti-condensation corrugated iron.

The Manhattan Electric company of New York, having outgrown its present quarters, is moving into its store at 32 Cortlandt street. The company's mill also use in addition the two upper floors it now occupies with the basement at the new place. The company has under way a number of new things in the electrical line which will be soon placed on the market. The call for the company's new telephone has been extensive and kept it very busy in manufacturing fast enough to meet the demand.

Charles Blizard, who, as general sales agent, has been introducing and pushing the sale of the Chloride accumulator in Chicago and the vicinity, has returned to the home office of the Electric Storage Battery company in Philadelphia. Mr. Blizard leaves the interests of the Chloride accumulator in the hands of Pierce & Richardson, 527 Manhattan building, Chicago. A number of installations of this storage battery have been made in the West, and Mr. Blizard reports the prospects for business to be excellent.

George L. Thayer, electrical engineer, for two years identified with the Westinghouse Electrical & Manufacturing company, has opened an office at 1439 Monadnock building, Chicago. He will do a general business in taking contracts for the installation and construction of electric lighting plants and also act as a consulting engineer of street railways. Mr. Thayer's chief specialty, however, will be power transmission, and with such a wide acquaintance with electrical interests as he possesses, combined with an active experience of four years, it is to be expected that he will achieve a conspicuous success.

Stanley Green, western manager of the Green Fuel Economizer company of Matteawan, N. Y., has just closed contracts with the Edward P. Allis company of Milwaukee, Wis., for one 500 horse power Green economizer for the East Boston, Mass., station; another of 500 horse power for the Deer Island pumping station and another of 300 horse power for the Charleston pumpine station. These economizers are all to be installed under a contract made by the Edward P. Allis company with the Boston sewerage commission. Such results as these indicate that Mr. Green's energetic management of the western territory is meeting with great success. In addition to these sales, negotiations are now under way, which, it is expected, will result in the installation of several more economizers of large capacity.

ELECTRICAL PATENTS.

Issued April 10, 1894.

517,831. Electric Power Appliance. Bion J. Arnold, Chicago, Ill.

517,858. Electric Motor. Edwin T. Greenfield, New York, N. Y.

517,862. Electrical Foot Bath. Isaac A. Isaacs, New York, N. Y.

517,884. Rail Connection. Theodore C. Paulsen, Chicago, Ill.

The rail bond is in the form of a cylinder, closed at one end and tapering at the opposite end, the end of the wire being inserted into the bore, after which the cylinder is driven into the hole provided in the rail. The tapering end causes the sides of the cylinder to approach and clamp the wire, the diameter of the cylinder being slightly larger than the hole in the rail. The capped end prevents the entrance of moisture or foreign substances, prevents the cylinder from being injured in driving and makes a more solid bond than an open-ended cylinder, due to the solid portion being wedged into the hole.

517,886. Electric Railway. Henry S. Pruyn, Hoosick Falls, N. Y.

The railway comprises a main insulated feeder and a sectional working conductor, the sections of which are supplied with current automatically as the car moves along, and are left out of circuit when the car passes. The sectional conductor, with its insulating supports, are adapted to be removed from the conduit bodily for the purpose of examination and repairs.

517,940. Electric Railway System. Charles D. Tisdale, Boston, Mass.

The method consists in providing a number of electric motors which will develop different counter-electromotive forces at like speeds of the car to which they are attached, and so connecting and operating the motors in series or singly that the several arrangements of motors will operate the car at different speeds for the same counter-electromotive force, or that corresponding to the voltage available even when the same current is used in all cases.

517,948. Method of and Means for Speed Regulation of Electric Locomotives. Charles E. Emery, Brooklyn, N. Y.

517,957. Electric Switch. Andrew T. MacCoy, Boston, Mass.

517,998. Electric Car Lighting System. William Biddle and Patrick Kennedy, Brooklyn, N. Y.

518,006. Electric Locomotive. William Lawrence, New York, N. Y.

518,015. Ice Cutting Trolley. Robert W. Thompson, Cleveland, O.

The trolley comprises a central disk grooved on its edge and peripheral rings secured by radial arms to the disk at either side, but separated from it by annular openings, the rings being provided with cutting inner edges. As the trolley advances the inner edges of the rings cut the ice from the wire, the ice dropping through the annular spaces.

518,033. Electric Motor. John C. Henry, New York, N. Y.

518,037. Electrical Annunciator. Robert L. Hunter St. Paul, Minn.

518,040. Electrolytic Cell. Ernest A. Le Sueur, Ottawa, Oat.

518,062. Speed and Power Regulator for Motors. Horace B. Gale, San Francisco, Cal.

The regulator is applicable either to electric motors or to steam engines, and comprises a dynamo electric machine geared with the motor and in circuit with a secondary battery. At normal speed the electromotive force generated by the machine equals the electromotive force of the battery, but if the speed fall below the normal, the battery sends current through the machine, causing it to rotate as a motor and assist the prime mover; if, on the other hand, the speed rise above the normal, the machine sends current through the batter , thus storing energy in the battery to assist the prime mover when the speed again falls below the normal and increased energy is demanded of the prime mover.

518,065. Electrolytical Apparatus. Carl Hoepfner, Giessen, Germany.

518,071. Trolley Wire Insulator. Louis McCarthy, Boston, Mass.

518,092. Permanent Magnet. Arthur T. Collier, St. Albans, Eng.

518,142. Telephone Transmitter. John Goodman and Henry M. Goodman, Louisville, Ky.

The operation of the telephone is based upon the principle that if iron filing be sprinkled upon the pole of a magnet, they will adhere together, and that if the pole be approached by the pole of a second magnet, the field being intensified, the filings will adhere closer together. The device comprises a stationary magnet, to whose pole adhere the filings, a second magnet with its pole opposed to that of the first being mounted to be moved by the vibration of the diaphragm. The circuit being closed through the iron filings, the resistance is thus varied, as the filings adhere with varying force, due to change in the strength of the field.

518,179. Electric Incandescent Lamp. John E. Criggal, Springfield, Mass.

Two tubes are provided in the neck of the lamp, closed at their ends with plastic material and filled with mercury, the leading-in wires passing longitudinally through the tubes and carrying upon their inner ends the filament.

518,190. Attachment for Operating Phonographs. Albert K. Keller, New York, N. Y.

518,191. Machine for Operating Phonographs. Albert K. Keller, New York, N. Y.

518,192. Machine or Attachment for Operating Phonographs. Albert K. Keller, New York, N. Y.

518,198. Adjustable Electrolier. Charles M. McCamey and Sebra H. Root, Longmont, Colo.

518,209. Attachment for Automatically Operating Phonographs. Ezra T. Gilliland and Frank W. Toppan, New York, N. Y.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents expiring during the week ending April 10, 1894:

189,298. Couplings for Lightning Rods. L. Bradley, Chicago, Ill.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, APRIL 28, 1894. No. 17

Electric Lighting of the New Chicago Tunnel.

Last Saturday marked the opening of the new tunnel at Van Buren street, under the Chicago river, constructed for the use of the West Side cable cars of the Blue Island avenue and South Halsted street lines, an event which means a great deal to those who have been obliged until now to depend upon horse cars for transportation. The tunnel is a very interesting piece of engineering work, and is, as well, the widest tunnel in the world in proportion to its length. Its construction has taken four years, and necessitated an expenditure of about $1,500,000, including the cost of rights of way and the settlement of litigation. The length of the new tunnel and its approaches, from the west side of Franklin street to the east side of Clinton street, is 1,513.9 feet, the arch being 15 feet 9 inches in height above the level of the car tracks, and having a span of 30 feet. It passes under the Chicago river, the tracks of the Pennsylvania Railroad company's yards, two six-story buildings and two seven-story buildings. In the plan, Fig. 4, is shown a profile of the tunnel and its approaches, the gradients being indicated. The steepest incline is a 10 per cent. grade for 499.1 feet; at the end of the 10 per cent. grade there is a grade of 1.81 per cent. for 100.86 feet, where the lowest point is reached. From this point the tunnel rises by three grades.

The lighting of the tunnel was not the least important of the subject which it was necessary to consider. The air there is naturally damp and the moisture considerable, and plans had to be made to keep a constant light at all times. Space was provided for a dynamo room and boiler room in one of the buildings on Market street, directly over the tunnel, which had been purchased by the company. Here, in a room about 25 by 30 feet, are installed three 60 kilowatt Waddell-Entz dynamos, directly connected to three McEwen high speed simple engines of 100 horse power capacity each, running at 275 revolutions per minute. The armature, of the outside gramme ring type is supported directly on the engine shaft and revolves outside of the pole-pieces, taking the place of the fly-wheel. The pole-pieces on each machine are energized by one exciting coil. The magnets, for any number of poles, are cast steel in two sections, consequently there is but one magnetic break. The advantage of homogenousness in the magnets is that the machines will regulate absolutely through the greatest variation of load. All dynamo connections are carried under the floor in iron piping. From the pumping room, next to the dynamo room, a shaft has been sunk about 55 feet deep, which connects with the tunnel, and through which are lead the cables which feed the low pressure arc lighting system used in the tunnel. Suspended from the roof are about 50 arc lights of 2,000 candle power each, 25 feet apart and wired two in series upon six circuits. The effect, an idea which may be gained by reference to Fig. 1, is exceedingly brilliant and is made more pronounced by the fact that the walls and ceiling have been whitewashed. The photograph was taken about half way through the tunnel looking toward the western end, and was made by the light furnished by the arc lamps. This is said to be the only tunnel in the world lighted by arc lights upon a 110 volt system. Nos. 0 and 000 Paranite wire is used to a great extent, and the arc lamps are of the Nutting company's manufacture. These lamps are of the constant potential type and as stated are run two in series on the 110 volt circuits. The Nutting arc lamp uses a heat feeding movement. It differs from the older types in that its feed is constant and does not contain magnets. From its interior mechanism it has been often called the wax wheel lamp. The award received at the World's Fair on this style of lamp was particularly broad, and the company claims that it received the only general award on arc lamps. The same feeding mechanism is equally well adapted to direct or alternating currents. The application of this type of lamp to this class of work has been watched with interest. In this installation a special form of resistance was used in series with the lamps, which thoroughly protects the resistance wire from contact with the moisture in the air. In Fig. 2 is shown a view of two of the dynamos, and in Fig. 3 may be seen an illustration of the third ma-

FIG. 1. ELECTRIC LIGHTING OF THE NEW CHICAGO TUNNEL.

chine and the switchboard. This board, which is 7 by 12 feet in size, is made of white Italian marble with red Tennessee trimmings and presents a very tasteful appearance. It contains three equalizing switches of 600 amperes carrying capacity each, 12 circuit switches of 200 amperes

FIG. 4. ELECTRIC LIGHTING OF THE NEW CHICAGO TUNNEL.

carrying capacity each, three ammeters, a voltmeter, ground detector and the other usual switchboard instruments, all of Queen & Co.'s manufacture. The equalizing bus bars are behind the board and all the connections are made upon the back of the board. The capacity of the dynamos is much in excess of the present demand, and it is intended by lighting the surrounding buildings to run about 100 arc lamps and in the neighborhood of 2,500 incandescent lights from them. The wiring is not as yet in a completed condition, as much of it is of a temporary character put up hastily to meet the demands for light by workmen before the completion of the structure and for an early opening for traffic. The conduit of the Interior Conduit company will be used to a considerable extent. At the entrances handsomely designed ornamental arc light hangers have been placed, and the lighting effect is certainly worth a trip through the tunnel. The electric plant was designed and installed by George Warren Furbeck, Chicago.

Lamp Lighting Schedule.

Following is the WESTERN ELECTRICIAN'S moonlight schedule for May:

Day of Month.	Light.	Day of Month.	Extinguish	Number of Hours.
	H M		H.M.	H.M.
1....	P. M. 7.30	2....	A. M. 4 00	8.30
2....	" 7 30	3 ..	" 3.50	8 20
3 ..	" 7.30	4....	" 3 50	8.20
4....	" 7 30	5....	" 3 50	8 20
5 ...	" 7 3	6...	" 3 50	8.20
6 ..	" 8 00	7....	" 3.50	7.50
7...	" 9.10	8....	" 3 50	6.40
8 ...	" 10 20	9 ..	" 3 50	5.30
9..	" 11 10	10....	" 3 50	4 40
10....	" 12 0	11....	" 3.40	3 40
12....	A M. 12.3	12....	" 3 40	3 10
13....	" 12.50	13 ..	" 3.40	2.50
14....	" 1.20	14....	" 3 40	2.20
15....	" 1.40	15 ..	" 3.4	2.00
16...	" 2.00	16....	" 3 40	1 40
17....	" 2.20	17....	" 3 40	1.20
18....	No light.	18 ..	No light.	0.00
19....	No light.	19....	No light.	0 00
20....	No light.	20....	No light.	0.00
21....	P M. 7.50	21...	P. M. 8.50	1 00
22....	" 7 50	22....	" 11 40	3.50
23 ..	" 7.50	24 ..	A. M. 12.20	4 30
24....	" 7 5	25....	" 1.00	5 10
25....	" 7.50	26....	" 1.30	5.40
26. ..	" 7 50	27....	" 1.50	6 00
27....	" 7.50	28....	" 2.10	6 20
28...	" 7.5	29....	" 2.30	6.40
29....	" 7 50	30....	" 2 50	7.00
30 ..	" 7 50	31 ..	" 3 10	7.20
31....	" 8 00	June 1	" 3.30	8.30
		Total.....		145.30

The foregoing schedule was calculated on the following basis:
Light one-half hour after sunset and one hour before moonset.
Extinguish one hour after moonrise and one hour before sunrise.

American Institute of Electrical Engineers.

The eighty-sixth meeting of the Institute was held at 12 West Thirty first street, New York, April 18th. The sec-

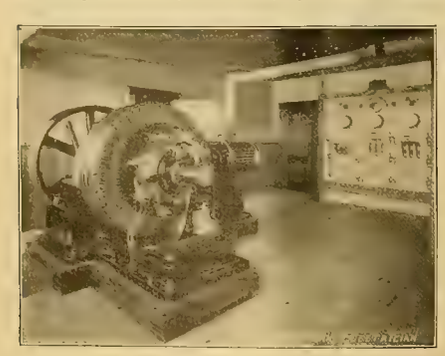


FIG. 3. ELECTRIC LIGHTING OF THE NEW CHICAGO TUNNEL.

retary announced the death of Dr. Franz Schulze-Berge at Brooklyn on March 21st.

Upon recommendation of the committee upon units and standards, an informal vote was taken expressing the sense of the meeting as favorable to the passage of the bill by the United States Congress, legalizing the electrical units adopted by the Electrical Congress of 1893 at Chicago.

The paper of the evening was read by I. H. Farnham of Boston on the "Destructive Effect of Electrical Currents on Subterranean Metal Pipes," and was profusely illustrated with lantern slides. This paper is presented elsewhere in this issue. The discussion was opened by Prof. Plympton of Brooklyn, and participated in by Messrs. Kennelly, Emery, Waldo, Houston and others. A communication upon the subject was also read from Mr. Lockwood. Other communications from Prof. Thomson and Mr. Lemp were received too late to be read at the meeting.

At the meeting of the council in the afternoon the following named associate members were elected:

A. T. Best, Hotel Ponce de Leon, Florida; Charles A. Carus-Wilson, Montreal, P. Q.; Frank R. Colvin, New York; John C. George, Baltimore, Md.; James H. Gerry, New York; James Wm. Gladstone, West Orange, N. J.; Henry M. Hobart, Schenectady, N. Y.; Ralph O. Hood, Boston, Mass.; William C. Hubbard, New York; Eugene Ingold, Pittsburg, Pa.; Edwin S. Keefer, New York

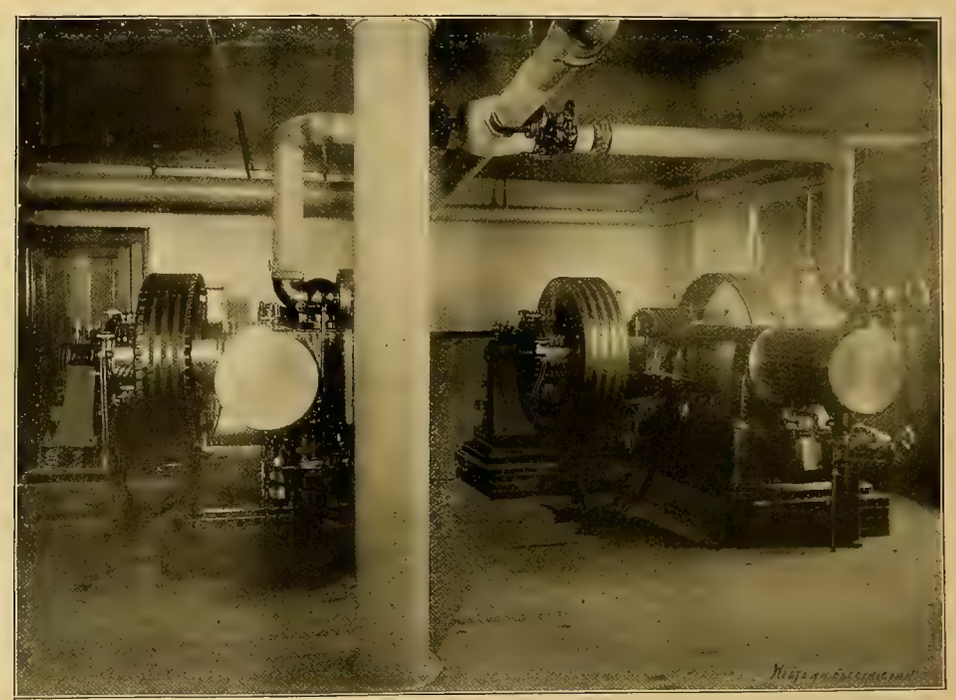


FIG. 2. ELECTRIC LIGHTING OF THE NEW CHICAGO TUNNEL.

Charles H. Macloskie, Chicago, Ill.; Samuel G. Neiler, Chicago, Ill.; Thomas L. Proctor, Newton, N. Y.; A. L. Searles, New York; C. J. Toerring, Jr., New York; Walter S. Wiley, South Omaha, Neb.

The following named associate members were transferred to full membership upon the recommendation of the board of examiners:

S. Dana Greene. Schenectady, N. Y.; Rudolph Eickemeyer, Yonkers, N. Y.; John Thomas Morrow, Great Falls, Mont.; A. Langstaff Johnston, Philadelphia, Pa.; Joseph Edwin Crandall, Washington, D. C.

Elmer G. Willyoung, Philadelphia, informed the secretary that active preparations were being made for the coming annual and general meeting of the Institute May 15th, 16th and 17th. The Engineers' club has offered to throw open its house for the use of the Institute, and it is proposed to make the Bingham House the headquarters.

The annual meeting will be held in the afternoon of May 15th. The result of the election will be announced the reports of the council and treasurer read and the revision of the election rules and the recommendations of the committee on units and standards will be considered. The annual dinner of the Institute will be held in the evening. Wednesday and Thursday will be devoted to the reading and discussion of papers, the list reported by the committee being as follows:

"Discriminating Lightning Arresters and Recent Progress in Means for Protection against Lightning." Alexander Jay Wurts.

"The Law of Hysteresis (Part III.) and the Calculation of Ferric Inductances." Charles P. Steinmetz.

"Alternating Currents and Fuse Wires." Dugald C. Jackson and R. J. Ochsner.

"The Waste of Zinc in Open Circuit Batteries when standing Idle." Henry A. Lardner.

"Some Storage Battery Phenomena." W. E. Griscom.

"Central Station Economy." C. Reginald Van Trump.

"A Review of the Progress of the American Institute of Electrical Engineers." Edwin J. Houston.

"Standardizing Electrical Measuring Instruments."

(*a*) By the potentiometer method.

(*b*) An improved direct reading potentiometer. Elmer G. Willyoung.

"Experiments with Two-phase Motors." Louis Duncan.

"Test for Closed Coil Arc Dynamo," R. B. Owens.

"Relative Advantages of Toothed and Smooth-Core Armatures," Alton D. Adams.

"Resonance Analysis of Alternating and Polyphase Currents," Prof. M. I. Pupin.

In the April number of the Institute *Transactions*, Figs. 6 and 13 were transposed, and on page 204, third line from bottom, the word "positive" should be "negative."

Destructive Effect of Electrical Currents on Subterranean Metal Pipes.[1]

BY ISAIAH H. FARNHAM.

Early in the summer of 1891 some lead-covered telephone cable removed from wooden ducts in Boston showed some very marked yet local spots of corrosion. The cause of the corrosion was generally attributed to acetic acid contained in the wooden conduit, which had, years before, caused corrosion on a few cables in certain sections of the city. In the case just mentioned, the corrosion was so severe, and located in spots only, that it led me to attribute the cause to electrolytic action from the railway currents, and a letter was written to my company to that effect.

A few months later the lead covering of a cable (No. 208) resting upon the ground in manhole chamber No. 76, located at the corner of Berkeley and Newbury streets, was found eaten entirely through at the point of contact with the earth. I then felt certain the cable had been destroyed by the action of the current. With W. I. Towne, my assistant, I proceeded to prove the theory.

We took measurements between the cable and the earth, the cable having been repaired and raised from the ground, and found 1.5 to 2 volts difference of potential, the cable being positive to the earth. A barrel of earth was procured from an excavation in the street, a metal plate placed beneath the earth in the barrel, and two short pieces of lead cable placed side by side on top of the earth. The plate in the bottom of the barrel was then connected to the negative side of a storage battery giving four volts potential, and one piece of the cable lying on the earth was connected with the positive pole of the storage battery. The second piece of cable in the barrel was left without electrical connections. The earth was then saturated with water and the circuit was closed, allowing the current to pass from battery to cable, to earth, to plate and to battery, for seven consecutive days. The pieces of cable were then removed and the piece which had been connected with the battery was badly pitted, closely resembling the cable which had been destroyed, while the second piece of cable showed no corrosion whatever, proving conclusively that a current such as was found in the manhole was sufficient to cause the damage that had been found, and that the corrosion was not, in the case of the experiment at least, due to any acid or salts in the earth.

Fig. 1 shows the barrel experiment, and Fig. 2 is a reproduction of a photograph of the cable No. 208 which has been described as found resting on the earth in the manhole chamber and and corroded through; also the pieces experimented upon in the barrel. That shown in the center of the illustration is cable No. 208.

1. Read at the meeting of the American Institute of Electrical Engineers, New York, April 18, 1894.

In addition to the experiment just mentioned, we placed in the bottom of manhole chamber No. 76 two short pieces of cable, one of which we connected by a wire to cable No. 208, which had been damaged by electrolysis. It should be understood that the damaged cable had been repaired, and removed from the bottom of the chamber. Fig. 3 shows the arrangement of this experiment. At the end of six weeks the pieces of cable were removed and examined. The one which had been connscted with cable No. 208 was deeply pitted,[1] while the other piece was free from corrosion, as shown in Fig. 4, which is from a photograph of them.

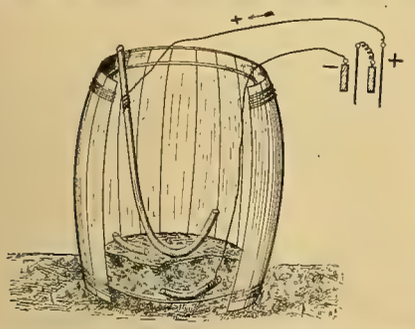


FIG. 1. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

These experiments, with several others of minor importance, satisfied all who were interested that electrolytic action was destroying cables and probably gas and water pipes.

It next became necessary to prove to the electrician of the railway company that the current causing electrolysis was from the railway system, and not from a leak in the Edison or some other electric lighting system.

Measurements were made between the cables in all manholes and the earth near the cables for voltage and direction of current. It was found that within a radius of about 2,000 feet from the Albany street power house cables were negative to the earth, ranging from zero to two volts, and that outside of this neutral line they were positive to the earth from zero to 12 volts. This condition prevailed until a point was reached near the East Cambridge power house, when they again passed a neutral line and became more and more positive as that power house was approached. The same conditions were found as the Allston railway power house was approached. On obtaining sufficient data, maps were drawn showing voltage between cables and earth throughout all sections of the city. This is shown in map, Fig. 5.

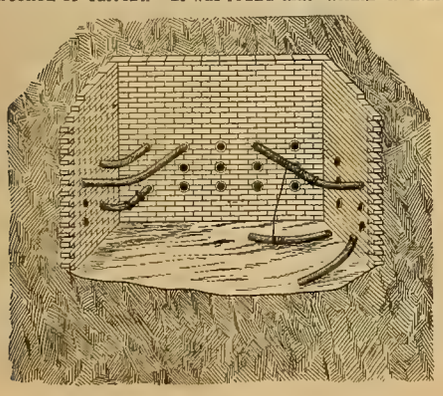


FIG. 3. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

1. The plumbers of Omaha, Neb., apply the name of "small-pox pipe" to that pitted by electrolysis.

In addition to the figures placed beside the several routes of cable conduits, showing the direction of current and its pressure, we have colored red such portion of the map where at that time we found the cables positive to the earth. We may call the red portion of the map the danger territory. These potential measurements, though taken for other purposes, incidentally furnished all the proof needed to convince one that the railway power was the source of the troublesome currents. At the time the map was made, and previously, the railway was operating with the negative pole of the dynamo to the trolley, the positive side being to the rails.

Fig. 6 is intended to illustrate this condition. It shows the passage of current from the dynamo to the rails, and the passage of a portion of the current from the rails to the cables within the neutral or zero line, and from cables to rails outside of this zero line. The danger of electrolysis is only where the current is leaving the cable or pipe through the moist earth, hence the dangerous district was at this time outside of the zero or neutral line, as shown both on the map, Fig. 5, and in this Fig. 6.

Having outlined our early experience in running down this new trouble, we will next mention some of the proposed and applied remedies. Several conferences were held for the purpose of suggesting and discussing means for preventing the destruction of the cables, at which the officers and experts of both the railway and telephone companies were present, and it should be said that the railway company in Boston has shown a disposition to adopt any promising plan for overcoming the evil, save, perhaps, the abandonment of the rails and earth as a part of the circuit.

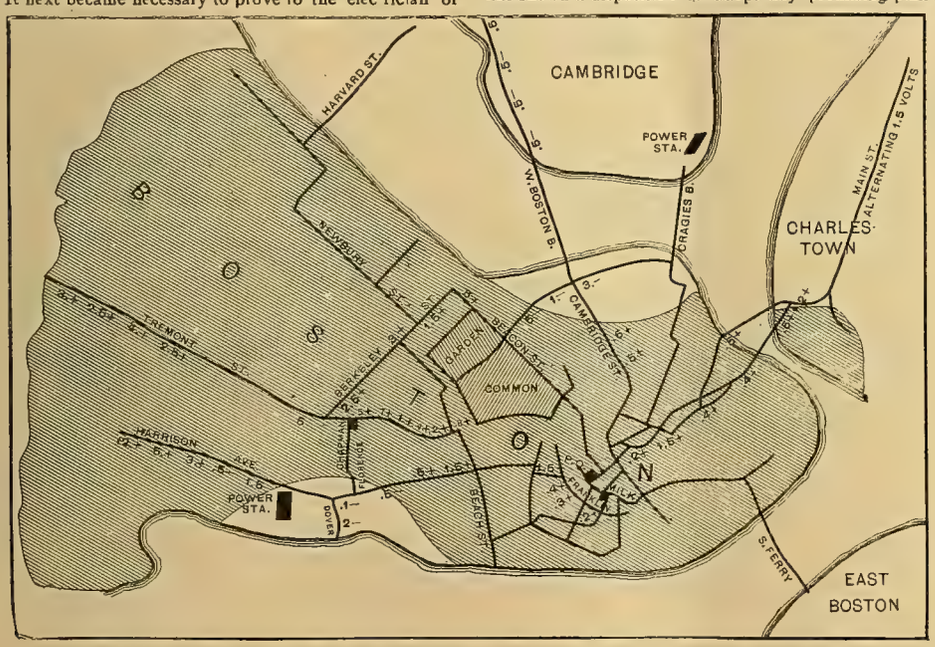


FIG. 5. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

Showing where corrossion was going on when first brought to notice. The shaded portions of the map are referred to in the paper as colored red.

First—It was proposed to remove all cables from the wet bottom and sides of the so-called manholes. It was found very difficult to place and retain cables free from the wet sides, and even could this have been accomplished, the action at the mouth of the ducts and within them would still have continued. They were, however, all removed from the bottom of the manholes.

Second—It was suggested that the cables might be connected to ground plates in the manholes, and so transfer the electrolytic action to these plates, and thus save the cables. This experiment was tried on an extended scale, but though many ground plates having a surface of several square feet each were connected with the cables over a large portion of the city, it was found that voltmeter readings taken between the cables and a point on the earth a short distance removed from the ground plate in any manhole, gave nearly the same pressure as before the ground plates were connected.

In some cases the voltage between the cables and the earth was reduced 25 per cent.; in many others no noticeable reduction was made. The ground plates were constructed from pieces of old lead cable, 6 to 10 feet in length and embedded in the wet earth at the bottom of the manholes. It was evident from this test, that ordinary ground plates would not prove of material advantage for protecting the cables.

Third—Prof. Elihu Thomson suggested, among other possible remedies, the placing of motor-generators at different points along the railway line, wherever the cables and pipes are found to be in danger, the motor generators to be operated by the railway power current; the secondary current developed by these generators to be utilized to lower the potential in the cables and pipes to zero, with respect to the surrounding earth or rails. The suggestion included means for automatically starting and stopping the generators, as cables might become positive or negative to the rails. The motor-generators would, so to speak, pump the current of the cables and force it into the rails whenever the potential of the former should rise above zero. Fig. 7 illustrates this suggestion. This plan has not yet been put into operation so far as I am aware.

Fourth—Insulating the cables and pipes from the earth was proposed. As some of the worst cases of corrosion of cables by electrolysis occurred where they were painted with asphalt, taped, painted again, and finally covered again with a heavy braiding also saturated with asphalt, it was apparent that to insulate cables sufficiently to protect them would be difficult and expensive, if indeed practically possible. Figs. 8 and 9 show specimens of corrosion of cables which had been treated with asphalt, tape and braiding. To protect water and gas pipes by a sufficient insulating jacket was seen at once to be impracticable.

FIG. 4. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

Fifth—Breaking the metallic continuity of the cable sheath and pipes was proposed. From the fact that severe action is frequently found in comparatively isolated spots, where cables and pipes cross each other or pass near or across the rails, it follows that any system of breaking the metallic continuity would have to be studied with reference to the entire complicated system of pipes, cables and rails ramifying through the streets of a city. There would also be a difference of potential between the several sections of cable or pipe, severed metallically, tending to cause electrolysis at one end of each section, as illustrated in Fig. 10. In case of water pipes treated in this manner, the action might be expected on the interior as well as on the exterior.

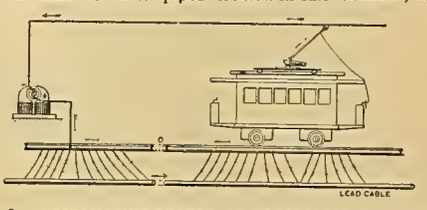


FIG. 6. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

There appears to be some evidence of such an action as this in gas and water pipes where the electrical continuity is partially broken by leaded joints. Fig. 11 shows an iron service pipe from the Cambridge gas system. It will be noticed that the action is most severe at points immediately on either side of the coupling. The reason the corrosion appears on both sides of the coupling in this case is not clear; it may be due to reversal of current on the railway system. We have observed other specimens similar to this, which may tend to show that for currents of low pressure the resistance of joints materially affects the results. I will again refer to this question in connection with potential differences in water mains.

Sixth—My assistant, Mr. Towne, suggested that the railway current might be so frequently alternated as possibly to prevent serious action on the pipes and cables. The theory was that before the oxygen gas, liberated by the current, should have time to attack the metal, the reversal of the current would disperse it. A careful experiment was conducted, extending over a period of ten days, employing a pressure of current of from three to seven volts, and alternating its direction at regular periods of one minute, by specially devised apparatus, No material change had taken place in either plate during this period of time. We then considered the practicability of reversing the railway current frequently. It seemed possible to reverse it once each 24 hours, at a given time in the night when the load is comparatively light. To do this in a large system involving several power stations would require

FIG. 2. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

either a loss of current for a few minutes in order to guard against one station reversing before some other had opened or reversed its current, or would require some electrical system connecting the several stations together and operating the reversing apparatus simultaneously. We concluded it would be very difficult, if indeed at all practicable, to reverse such heavy currents during regular traffic. We then renewed the reversing experiment, giving 24 hour periods between each alternation, but found at the end of two weeks, to our sorrow, that the plates subjected to the action of the current were seriously electrolyzed. It seemed useless to pursue this line of work further at that time. When alternating current motors become practicable for use on street cars, advantage may be taken of the fact that such currents appear not to cause electrolysis to

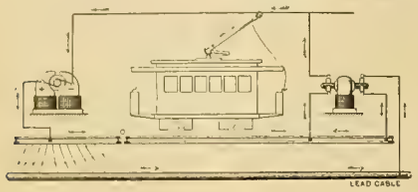


FIG. 7. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

the extent of injuring pipes and cables exposed to them.

Seventh—At about this stage in the study of the problem Fred S. Pearson, then engineer of the West End Street Railway company, made two suggestions which, though separate in themselves, and presented at different dates, yet carried out in conjunction, have proved exceedingly helpful in overcoming the difficulty, at least so far as relates to telephone cables. It occurred to Mr. Pearson first, that if the railway current should be reversed so that the positive pole would be connected with the trolley, the danger of electrolysis would be removed from the greater and more scattered portion of the city, and be brought near the power stations where it possibly could be more easily dealt with. This reversal was made and the expected potential changes between cables and earth followed. Fig. 12 is a map of Boston, showing the condition after the reversal of current. The red or dangerous portions in this map correspond to the white or safe districts in the map shown in the first part of this paper (Fig. 5), the only variation being that by the reversal, the neutral or zero line was thrown out a little farther from the Albany street power house than it was located before. It was also noted that the cables near the power house, which had been from one to two volts negative to earth before the change of current, were now one to nine volts positive to earth; that is, they were raised higher above zero than they had been

FIG. 8. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

below zero prior to the reversal. Fig. 13 is a typical representation of the current flowing through trolley, car, rails and cables at this time. It will be readily understood that, with the conditions as illustrated in this figure, the electrolytic action would be confined to the territory comparatively near the power stations where the current is leaving the cables to reach the negative or rail side of the dynamo.

Mr. Pearson next suggested the plan of running out large copper conductors from the negative side of the dynamo and extending them through the dangerous district, connecting them at frequent intervals to the cables. Fig. 14 diagrammatically illustrates this plan. On the principle involved in Prof. Thomson's motor generators this low resistance conductor connected directly to the dynamo was to pump the current from the cables, and so prevent its passage into or through the moist earth. Some of us were skeptical as to the completeness of this proposed remedy. It seemed possible that, even with such a good return conductor, some of the current might still pass into and through the earth. Voltage measurements, however, at once dispelled the doubts, for we found that the

FIG. 9. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

cables measuring nine volts positive to earth gave a reading of twenty-two positive to the return conductor; that is, the return wire, as relating to the cables, was at all points more negative than the earth (if we may be allowed the expression). The return conductors were made up of a large number of No. 18 copper wires, formed into cables about one inch in diameter, known as conductors of 500,000 circular mils. These conductors were extended in each direction, from Albany street power house entirely through this dangerous district, its longest section being about 4,300 feet. The cables in every manhole within the district were connected by several No. 12 copper wires to the return conductor and soldered. On first connecting the cables to the return conductor, which took place December 24, 1892, the current was sufficient to melt several strands of No. 12 wire. A measurement for current flowing in the main return conductor, which was used for relieving the cables only, gave about 500 amperes. It may be interesting here to note comparative voltages in the district near the power house, as given in the accompanying table:

Manhole No.	First Measurement to earth	After Reversal of Railway Current.	Between cable and Return Conductor	Between Cables and Earth after Return Conductor was connected to Cables
263	1.5 +	0.3 −	22 +	4.5 −
264	1.5 +	.5 +	22 +	4.5
265	0.5 +	0.5 +	22 +	
266	0.5 −	2.8 +	22 +	0.8 −
267		4.8 +	23 +	
268	1	5 +	22 +	.5 −
310	1.5 −	3.5 +	22 +	1.5 −
269		4 +	22 +	
270		0.5 +	22 +	
271	.5 −	0.5 +	22 +	1.5 −
272		0.5 +	22 +	0.5 −
273		9 +	22 +	1 −
274	1.5 −	9. +	22 +	2.8 −
276	0.5 +	7 +	24 +	2 −
277		2 +	22 +	
278	.5 +	0.5 +	24 +	5 −
279		1 −	22 +	7.5 −
280	1 +	.5 −	22 +	7.5 −
305	1. +	0.3	22 +	3.8 −
306	0.5 +	0.5 +	22 +	3.8 −
307	0.5 +	2.5 +	22 +	
308	0.5	4. +	22 +	
309	1 −	4 +	22 +	3 −
311	1 −	2.5 +	22 +	
312	.5	2.5 +	22 +	
313		3.0 +	22 +	0.5 −
314	1	2.5 +	22 +	2.5 −

Fig. 15 is from a photograph taken in one of the manholes, showing the connection of the cables to the return conductor; the limited size of the manhole prevented my obtaining a view of all the cables.

The map, Fig. 16, illustrates the condition after the installation of the return conductor at the Albany street station. The red patch which existed in that locality is now removed, and the cables are all negative to earth. The remaining red patches or dangerous sections were corrected by taking similiar means of reaching the East Cambridge power house. In treating the latter case many measurement were made to determine whether or not the railway return wires, put up to take the current in a measure from the tracks, would answer for a return for the cables, instead of using a special return conductor as had been employed at the Albany street district. It was found that they would not answer, since the potential of these track return wires varied constantly and was frequently above that of the earth.

The cables on the Boston side of the draw of West Boston bridge proved to be positive to both the rail and the water, while on the other side of the narrow draw the opposite condition existed, showing at

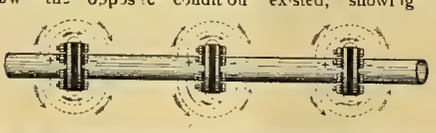


FIG 10. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

once that was unsafe to assume any neutral lines or potential difference without making measurements to determine the absolute facts.

So far, this paper has dealt particularly with the subject of protection of lead covered cables. It might be inferred that water and gas pipes can be treated in precisely the same manner with the same results, or, as water pipes have a much greater sectional area of metal, it might be presumed that simply a connection of such pipes to the dynamo at the power station would be sufficient to bring their potential down to zero throughout the dangerous district. The facts so far coming to our notice would materially modify such inferences, and therefore should find place here.

That iron pipes are as truly subjected to the corrosion as lead need not be stated to the members of this society, but for the benefit of city officials and others who may read the paper it should be plainly stated that they are quite as readily destroyed by electrolysis. Fig. 17 is from a photograph of an iron gas pipe taken from Brooklyn, N. Y.

The city engineer of Milwaukee, G. H. Benzenberg,

FIG. 11. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

has kindly sent me a photograph of a six-inch iron water main badly corroded. It is the best specimen of cast-iron pipe I have been able to obtain, although not the most serious case of corrosion. Fig. 18 is from the Milwaukee specimen.

Mr. Benzenberg writes that the trouble in that city was chiefly noticed upon the six-inch water main extending 100 feet on each side of a point opposite the railway power station. Services entering this main were also destroyed, and all were renewed three times during the last two years. He states further, and I quote his own words, "At other points where power houses were established thereafter the mains were immediately connected by extra heavy copper wires with the generator; we have had no trouble with them so far."

O. H. Tripp, engineer at Rockland, Me., recently furnished me with a specimen of wrought-iron pipe destroyed in five months; the fact is of special interest as it comes from a city having but a small railway system.

In Boston there have been water as well as gas service pipes corroded through by electrolysis. I have not learned of any mains having burst from this cause. Measurements of water pipes in the city indicate they are still in danger, notwithstanding several thoroughly made connections with the pipes at the power station; the same is true in Cambridge, Mass. This leads me to call attention to an interesting series of inquiries.

The engineer of the Executive Board at Rochester, N. Y., suggested to me, a short time ago, while looking into the question of electrolytic action upon the pipes in that city, that possibly there might be sufficient resistance in the joints of the water mains to cause an action upon the lead ring which forms the connection between sections of pipe. He stated that not unfrequently there is found a film of moisture between the pipe and this lead ring, and as the pipes are coated with a preparation of tar or asphalt on both the inner and outer surfaces before they are laid, there might be a poor electrical connection. Without having made any inquiries or tests upon this point, it seems to me probable that the careful calking which is given these lead rings would form in some portion of each joint a good electrical connection; that is, one of very low resistance. Recent measurements, however, made in Boston, and others made in Albany, during the latter part of March,

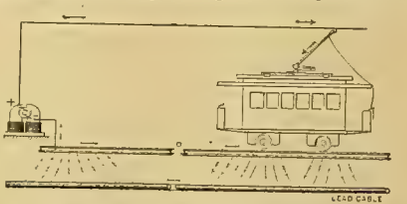


FIG. 13. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

this year, convince me that there is a very appreciable resistance in such joints.

Fig. 19 will illustrate the conditions at Albany. We found the negative side of the dynamo to be connected with the rails and with ground plates in old wells; no connection had been made with water or other pipes. Directly in front of the power station the voltmeter indicated a pressure of 20 volts between water pipe (an 8 inch cast-iron pipe) and the rail, the pipe being positive. A reading taken about 300 feet in either direction, up or down the street, indicated about 18 volts. At a point 1,200 feet north the reading was lowered to 12 volts. We then connected the rail side of the dynamo to the street hydrant and took new readings, finding 1 volt at the station, 7 volts at 300 feet distant, the same south, and 8 volts at a point 1,200 feet north.

These measurements, with similar indications in Boston, show plainly that there is a very appreciable resistance in the water main joints. At the same time the measure-

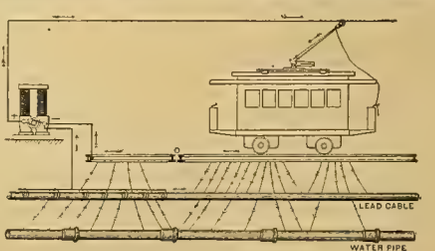


FIG. 14. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

ments give fair evidence that the difference of voltage between any two sections of water pipe is very small. The interested parties at Albany have kindly consented to allow any facts or figures obtained there in reference to this subject to be placed in this paper. Fig. 20 is from a photograph of a piece of service pipe at Albany. A few measurements made through the danger district will be of interest. The station is situated near the southern extremity of the city. The danger district extends north about one mile, and over this portion of the district the following figures were obtained. They were taken at nearly uniform distances of about 300 feet, beginning at the station:

MEASUREMENTS IN THE DANGER DISTRICT.

At Station,	Cable to Earth,	Positive,	12 volts.
" "	" " Rail	"	25 "
" "	Water " "	"	20 "
500 Ft. North,	Cable " Earth	"	10 "
" "	" " Track	"	22 "
" "	Water " "	"	12 "
1,000 "	Cable " Earth	"	6 "
" "	" " Track	"	18 "
" "	Water " "	"	12 "
1,500 "	Cable " Earth	"	6 "
" "	" " Rail	"	18 "
" "	Water " "	"	18 "
2,000 "	Cable " Earth	"	8 "
" "	" " Rail	"	16 "
2,500 "	" " Earth	"	6 "
" "	" " Rail	"	13 "
" "	Water " "	"	8 "
3,000 "	Cable " Earth	"	4 "
" "	" " Rail	"	11 "

At Station.	Cable to Earth.	Positive.	12 volts.
3,500 "	" " Earth	"	3 "
" "	" " Rail	"	12 "
" "	Water " "	"	7 "
4,000 "	Cable " Earth	"	3 "
" "	" " Rail	"	8 "
4,500 "	" " Earth	"	1 "
" "	" " Rail	"	1 "
" "	Water " "	Negative	1 "
5,000 "	Cable " Earth	Positive	½ "
" "	" " Rail	"	½ "

It is proposed at Albany to extend large wires (0000) through the dangerous district, one wire for each system

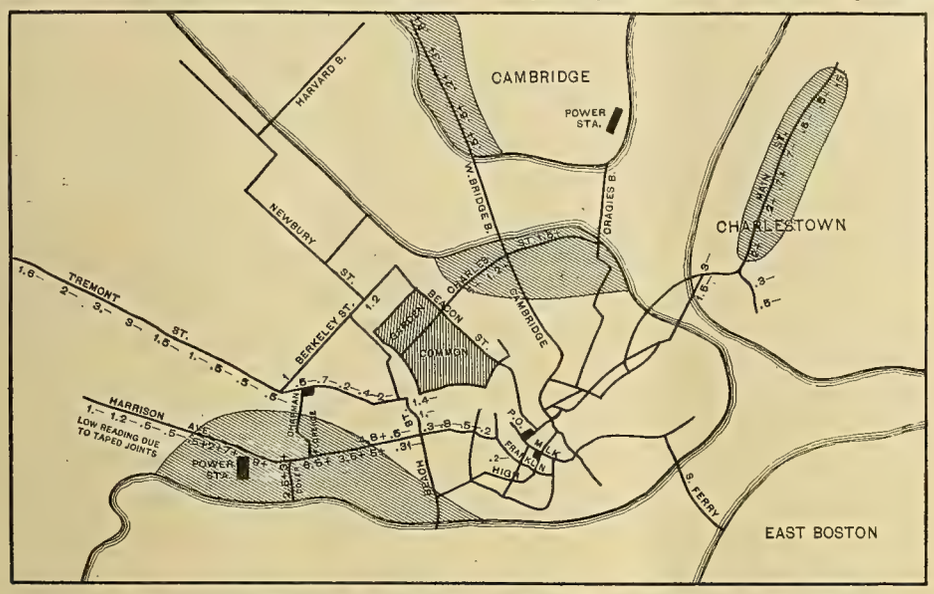


FIG. 12. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.
Condition after current was reversed by West End company. The shaded portions of the map are referred to in the paper as colored red.

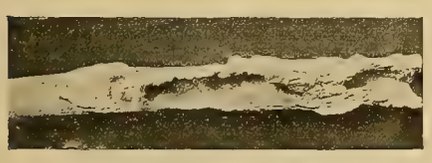
of pipes, connecting the pipes to them at frequent intervals.

It is probable that the remedy which has been applied to telephone cables in some cities has been the more positive from the very failure, so far, to thoroughly protect the other systems of pipes against electrolytic action. Fig. 14 (already mentioned) may assist to a clear understanding of this. The cables are here shown connected by a large wire to the dynamo,

FIG. 15. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

while water pipes are not so treated. Therefore, the current which enters the water pipes at points outside the danger district passes to the neighborhood of the power station, and, in leaving them there, raises the potential of the earth about the cables. In other words, the current flows from the water pipes to the ground and thence to the cables in order to reach the dynamo.

Connecting any one system of pipes to the dynamo will, in a measure, protect other systems of pipes but connecting all systems reduces the certainty or margin of certainty of



IG. 20. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

protection to any one system. This will be apparent from a little study of Fig. 14, just referred to.

When all cables and pipes in the danger district are connected by sufficiently large conductors to drain them, a careful adjustment in resistances in these several conductors may be found necessary in order to insure a balance between the several systems of pipes. It may lead to the necessity of reducing the carrying capacity of the conductor returning to the dynamo from the rails themselves.

The question has already arisen, and it doubtless will be repeated here: "How small a difference of potential between pipe and earth will cause electrolytic action?" In reply to this it may be stated that some of the worst cases of corrosion in Boston have occurred where the difference was but one and one-half volts. A. T. Wells of Chicago, in describing to me an examination of some of the first cases in Cincinnati, states that the "difference of potential between the cables and the rail was never more than one-half, and usually less than one-quarter volt." Such a difference between cable and rail would mean a much less difference between cable and earth, where electrolysis takes place. John C. Lee of Boston has experimentally caused the corrosion on lead and iron by a difference of potential of 1-100 volt.

The facts certainly indicate that but a very small pressure is necessary to produce the action and should dispel the numerous statements that well bonded rails or a large amount of rail return wires will alone overcome the trouble. In some cities where electrolysis is in progress

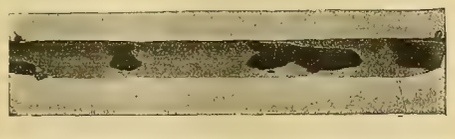


FIG. 17. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

to-day the return copper nearly equals that of the trolley and feed wire system. We cannot force the current to take one path exclusively when others are open to it.

The facts given above, with others similar, though not enumerated, lead me to the conclusions:

First—All single trolley railways employing the rails as a portion of the circuit, cause electrolytic action and consequent corrosion of pipes in their immediate vicinity unless special provision is made to prevent it.

Second—A fraction of a volt difference of potential between pipes and the damp earth surrounding them, is sufficient to induce the action.

Third—Bonding of rails or providing a metallic return conductor equal in sectional area and conductivity to the outgoing wires is insufficient to wholly prevent damage to pipes.

Fourth—Insulating pipes sufficiently to prevent the trouble is impracticable.

Fifth—Breaking the metallic continuity of pipes at sufficiently frequent intervals is impracticable.

Sixth—It is advisable to connect the positive pole of the dynamo to the trolley lines.

Seventh—A large conductor extending from the grounded side of the dynamo entirely through the danger territory and connected at every few hundred feet to such pipes as are in danger will usually insure their protection.

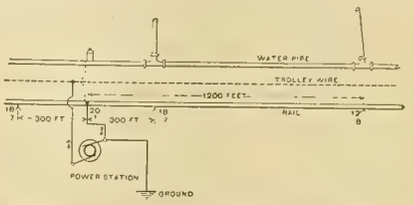


FIG. 19. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

Eighth—It is better to use a separate conductor for each set of pipes to be protected.

Ninth—Connection only at the power station, to water or gas pipes, will not ensure their safety.

Tenth—Connection between the pipes and rail or rail return wires outside of the danger district should be carefully avoided.

Eleventh—Frequent voltage measurements between pipes

FIG. 18. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

and earth should be obtained, and such changes in return conductors made as the measurements indicate.

Electric Railway Litigation.

A press dispatch from St. Louis contains the information that the suit of the Adams Electric Railway company against the Lindell Railroad company has been brought to trial in the United States Circuit Court of that city. The defendant company is using the Edison electric railway system, which is claimed to be an infringement of the patents granted to Dr. Wellington Adams for the application of electricity to railway locomotion. The real defendant, of course, is the General Electric company, which will defend the validity of its patents.

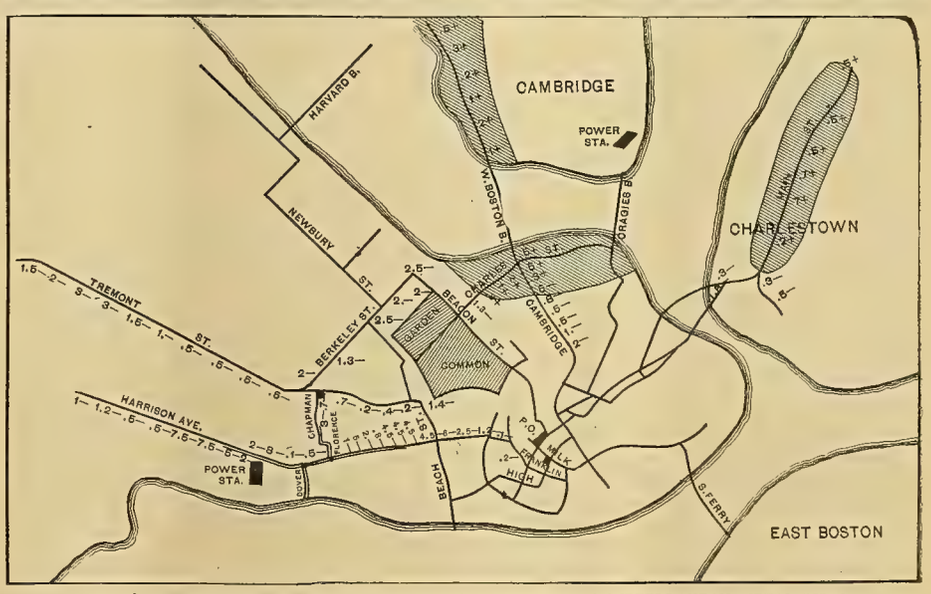


FIG. 16. DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.
Condition (Jan. 4) after connecting West End ground wire to cables near power station. The shaded portions of the map are referred to in the paper as colored red.

The bill for the operation of a municipal gas and electric light plant at Annapolis, Md., has been defeated.

Western Electrician.

EVERY SATURDAY.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK
CIRCULATION, 16,630.

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APROPOS of the recent patriotic celebration in Massachusetts, the *Boston Globe* remarks that "if Paul Revere had only waited until now he might have gone out a good part of the way on an electric car." True; but he might even have saved himself that trouble by calling up the villages he wished to alarm on the telephone. If Mr. Revere could re-visit the earth, he would find that electricity had provided him means for accomplishing his laudable object with neatness and dispatch and without stirring from his own dwelling.

ELSEWHERE in this issue is presented another contribution on the subject of the electrolytic action of street railway currents. Mr. Farnham's paper on the "Destructive Effects of Electrical Currents on Subterranean Metal Pipes" presents the views of telephone men on this subject, and the measures they have taken to overcome the troubles. Electric railway engineers have given this subject much attention, and several papers have been presented before their associations as well as at the last convention of the National Electric Light association. The telephone companies are opposed to the present practice in street railway construction, and in their opposition they have the support of waterworks and insurance men. In view of these facts it is evident that the street railway interests will be compelled to work out some solution of this problem, and every contribution on the subject, even though it may come from an unfriendly source, should receive attention.

THE Legislature of the state of New York is giving considerable attention to subjects affecting the electrical interests. Last week, when the Gerst bill to reduce the price of telephones throughout the state was called up it was expected it would pass the Assembly, as the Republican members had decided to make it a party measure. Despite the decision of the caucus, several of the Republicans voted against the bill, and others left the house in order to avoid voting upon the measure. As a result, the bill fell short 19 votes of the number required to pass it, and it is now believed that it will be impossible to secure enough votes to put it through.

The Board of Trade and Transportation of New York city which is advocating the passage of the telephone bill has passed resolutions requesting the Senate to instruct the judiciary committee to investigate the statement made by William H. Peckham in a speech recently delivered in New York city to the effect that he had reason to believe that the Metropolitan Telephone company pays $50,000 per year for "peace," the money being paid to city politicians, but enough of it being disbursed at Albany to procure the necessary "peace," and to direct the committee to report what influence, if any, such payments have had upon the defeat of the telephone bills. It is hardly possible that anything will come from this agitation, but it would seem as if the Metropolitan company would not care to rest under such a charge.

DR. WELLINGTON ADAMS' claim that he is the inventor of the application of electrical power for the operation of street and other railways is now being tested in the courts. The nominal defendant is the Lindell Railroad company of St. Louis, but the burden of the defense will rest on the General Electric company, as the Sprague-Edison system is the one in use by the St. Louis company. The General Electric company owns the Green patents, and it will be interesting to observe whether these are brought in to invalidate Dr. Adams' claim of priority. This brings up the question, Who did first conceive the idea of operating a railroad car by an electric motor supplied with current from a stationary source? As is the case with so many other electrical inventions, the origin of this does not seem positively defined. Perhaps Moses Farmer, the lately deceased electrical inventor, is entitled to the honor, but there are several claimants. None of the investigators in the 40's and 50's seemed to deem their productions of sufficient importance to be patented; and, as the St. Louis case shows, there is a contention as to priority among the latter-day patentees. It is hardly to be expected that Dr. Adams' suit will work any revolution in the street railway business of the country, but it should bring to light some interesting testimony.

CHICAGO wants rapid transit in the outlying districts and on the cross-town lines, and the people favor the introduction of the trolley system as it is the only means of securing the desired service. The city council, the mayor and the street railway companies, however, while professing readiness to assist the people in securing relief, are pulling in different directions. As an illustration of this the action of the council last Monday night may be taken as a fair example. Ordinances were pending for the North Side trolley lines and at the same time a communication was read from Mr. Yerkes, in which he said he would not accept any ordinance which contained certain provisions obnoxious to the company. The council accordingly proceeded to insert these provisions and passed the ordinance. In the case of the South Side company the council was notified that the company would not accept ordinances which required it to light the streets upon which it operated electric cars, nor would it consider the construction of a conduit system. Thereupon the mayor announced he would not approve any ordinance that did not provide for lighting the streets and the council committee insisted that a conduit system be adopted for the cross-town lines. Altogether they have succeeded in getting the subject thoroughly complicated, and the outlook for rapid transit is not improved by these petty squabbles. It is about time the aldermen settled down to business, passed reasonable ordinances and insisted upon the companies complying with the requirements. In this they would have the support of the people and if the companies did not signify a willingness to comply it would be very easy to find means for compelling them to do so.

ATTENTION is again directed to the annual meeting of the American Institute of Electrical Engineers, which will be held at Philadelphia on May 15th, when the election of officers will be held. Western members of the Institute are particularly interested in this meeting, as the result of the election will in a large measure determine their future relations with the organization. The Institute at present is controlled by the same coterie that has been in power for several years, and it is evident that strenuous efforts will be made by this element to retain its grasp upon the management. There has been much dissatisfaction, however, and this has been brought about by the high-handed policy pursued. It is admitted that the present administration is by far the most unpopular that has ever directed the affairs of the Institute, and that there has never been such widespread dissatisfaction during any previous year of the organization's existence, nor has there ever before been such general opposition to the continuance in power of the dominant faction. Even in New York city, the stronghold of this faction, there has been much severe criticism of the management and the methods employed in the administration of the society's affairs, and this has provoked much bitterness in the ranks. There is no doubt that the work of the organization has been seriously hampered by the factional fights which have been indulged in, and the influence of the association has been lessened by reason of these dissensions. It seems under the circumstances that the interests of the organization would be promoted by the retirement of the dominant faction and the election of non-partisan officers. But this is not to be accomplished without a struggle, if, indeed, it will be accomplished at all. The council's ticket contains the names of the representatives of the clique which is now in control of the Institute, and this element is determined to secure "vindication" if possible by the election of its ticket. It is interesting to note that the council nominees do not include the name of a single western member, although there has been much talk about building up the Institute in the West. It is true that many western members have been added during the last few years, and that this list includes many names which are known throughout the country. Here are a few of the men who have been identified with the electrical interests of the West, and who, although members of the Institute, have been passed over in order that the present administration might be vindicated:

Elisha Gray, Charles F. Brush, Lieut. F. B. Badt, Frank B. Rae, Leo Daft, Samuel Insull, R. H. Pierce, E. P. Warner, Charles Wirt, H. M. Byllesby, Prof. B. F. Thomas, C. T. Lindner, Lieut. W. F. C. Hasson, George P. Low, L. Searing, C. G. Armstrong, B. J. Arnold, E. M. Barton, A. H. Bauer, C. A. Brown, L. K. Comstock, C. D. Crandall, F. W. Cushing, George Cutter, C. C. Haskins, Angus S. Hibbard, C. H. Wilson, S. E. Nutting, Prof. M. O'Dea, Alex. Dow, Prof. George D. Shepardson, Prof. William Shrader, E. R. Weeks, Prof. R. B. Owens, E. P. Roberts, E. A. Sperry, W. C. Cheney, Hon. Geo. B. Shaw, Prof. John E. Davies, Prof. D. C. Jackson.

The best friends of the Institute have been striving to make that body truly representative in character of the electrical engineers of the country, and they have advocated a broad and liberal policy as opposed to the narrow course which the present management is pursuing. There is a large membership throughout the West that has no representation in the management, and it is evident that if the little clique now in control of the organization can have its way the same condition of affairs will continue. Already the "branch" meetings of the Chicago members have developed into a most ridiculous farce. No better illustration of this could be required than is presented by the April meeting. The New York meeting was held at the usual time, the paper of the evening was read and discussed, and given out for publication in the electrical papers. The following week (April 25th) the Chicago members meet for the purpose of listening to this paper, which has already been published. The only possible excuse that could be made for calling the members together at such a time would be to show them a few lantern slides. The New York members evidently look upon the Chicago branch as a sort of kindergarten, and its members children who may be amused and kept in good humor by showing them nice pictures. Every self-respecting member of the Institute should resent the attitude which the New York body has adopted in its dealings with outside members.

Invention and Development of the Telephone.[1]

By Herbert Laws Webb.

As has already been said, after the introduction of the Edison carbon telephone and the Hughes microphone, the Bell telephone was relegated to the place of the receiving instrument of a telephone line, and microphonic telephones, on account of their much greater power, were used as the transmitting instrument. So that it has come about that all magnet telephones are generally spoken of as receivers, and carbon telephones as transmitters. Notwithstanding this there have been cases where magnet telephones have been used as transmitters as well as receivers for regular exchange service. In Germany the Siemens telephone, already described, was largely used as a transmitter, and in Manchester, England, where an opposition exchange service was started before the expiry of the carbon transmitter patents, the new system was operated for some time with magnet transmitters with excellent results.

Carbon transmitters may be generally divided into three classes, viz., those that employ a single contact for varying the resistance of the primary circuit, such as the Blake; those that employ several contacts, of which there is a large number, all of them modifications of the original Hughes microphone, and those that employ granulated carbon, known as the Hunning type, after the originator of this idea.

In this country only three forms of carbon transmitter are in general use, the Blake, the "long-distance" and the

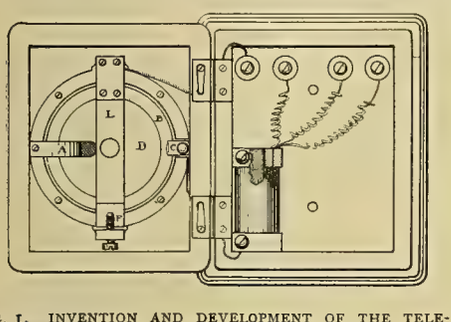


FIG. 1. INVENTION AND DEVELOPMENT OF THE TELEPHONE.—BLAKE TRANSMITTER: B, RUBBER BAND; C, CLIP; A, DAMPER; L, IRON BRACKET; F, ADJUSTING SCREW; D, DIAPHRAGM.

"solid back." The two latter are modifications of the Hunning transmitter, employing carbon granules. In Europe the variety of carbon transmitters in use by different companies and administrations is very large. A great many of these are microphonic transmitters pure and simple, containing a greater or lesser number of carbon pencils arranged in a more or less fantastic manner.

The patents covering the carbon transmitter are owned by the American Bell Telephone company. The Berliner patent, which was issued at the end of 1891, contains some very broad claims, and practically covers every possible form of carbon transmitter, having two "electrodes in contact with each other." The Edison patent, issued a few months later, makes a good second to the Berliner. These two patents were in interference in the Patent Office for a number of years; they were eventually both issued, and are now controlled by the Bell company, which also holds the patents on various special forms of transmitters, such as the Blake, "long distance," "solid back" and others gotten up in the laboratory of the company.

THE BLAKE TRANSMITTER.

The Blake transmitter, Fig. 1, is the standard instrument for local work in the United States, and is also the principal transmitter used in Canada and Great Britain. It is a fairly good all a round instrument of comparatively simple construction, cheap in first cost and cheap to maintain, as it requires small battery power. Its chief disadvantage is the necessity of very careful adjustment to get good results in the first place, and of frequent inspection and readjustment to keep it up to the point of giving good transmission. When well adjusted and properly taken care of, nothing better could be desired for lines of moderate length. The construction of the Blake transmitter appears complicated at first sight, but in reality it is very simple; each of the parts has an important function to perform, and on all being in good condition depends the efficient working of the instrument.

The variable resistance is made in the following way: A slender spring carrying a platinum contact point bears on the center of the diaphragm. A second spring carries a button of compressed carbon let into a rather heavy socket of brass. The face of the carbon button presses lightly on the platinum contact point of the first spring. The vibrations of the diaphragm cause the pressure of the platinum point on the carbon button to vary, resulting in a variation of the resistance at the contact. The secret of the good working of the instrument is that the two sides of the contact have no rigid bearing. In Edison's first transmitter he made one carbon contact solid with the case and the other solid with the diaphragm. Consequently, the variable contact was not sufficiently "sympathetic," as it were, with the vibrations of the diaphragm, and the instrument did not work well. Blake discovered the reason of the defect and applied the remedy.

In the Blake transmitter the carbon button "stands up" to the platinum contact, securing the full effect of the variations in pressure because of the weight of the brass socket; that is, because of its inertia, or resistance to be set in motion. The platinum contact is held against the diaphragm by the carbon button, but the normal set of its spring is toward the button and away from the diaphragm. Consequently we have a delicately balanced arrangement that is susceptible to change by the least vibration communicated by the diaphragm to the platinumpoint. A sectional view is shown in Fig. 2.

The arrangement of the parts to allow of proper adjustment of the springs is very ingenious. An iron ring is attached to the inside of the case, this ring having a bracket, or projection, top and bottom. To the top bracket is attached a piece of angle iron bent at its upper part to a right angle, at the lower part to an obtuse angle. The lower bracket serves as a bearing for the screw by which the iron support may be adjusted. The top part of the support carries the two springs, which are insulated from each other by hard rubber washers. The carbon spring is sheathed with a rubber sleeve, the diaphragm (generally of iron) is clamped over a rubber gasket, and is provided with a damper consisting of a metal spring screwed to the inside of the case. This damper is rubber-covered and has a little cloth pad that presses on the diaphragm near its center. The damper checks the vibrations of the diaphragm as quickly as they have done their work, preventing continued vibrations that would interfere with those following. The adjustment of the springs is effected by means of the screw bearing on the obtuse angle of the iron support. Turning the screw upward forces the support, and consequently the carbon button, toward the diaphragm, increasing the pressure between the button and the platinum contact. A reverse action of the screw allows the support to come away by reason of the outward set of the spring by which it is attached to the iron frame, resulting in a decrease of the pressure between the button and the platinum contact. The normal set of the spring with the platinum contact gives it a tendency to follow the carbon button, and if the button is pulled back the platinum contact should follow it nearly half an inch. The best adjustment is when the pressure of the carbon button on the platinum contact just holds it lightly against the diaphragm, not so lightly as to allow of any separation or break when the diaphragm is vibrated by the voices. The two springs of the transmitter are, of course, connected in circuit with with the primary wire of the induction coil and with the battery. The induction coil generally used in the Blake transmitter has a resistance in the primary of half an ohm and in the secondary of about 250 ohms.

1. From advance proofs of "The Telephone Hand-book," published by the Electrician Publishing company, Chicago (now in press). Price, $1.

New Cable Line to Europe.

The steamer Faraday left London, April 11th, with a portion of the new cable of the Commercial Cable company, which is to be laid from Waterville, on the coast of Ireland, to Nova Scotia. The Faraday is not large enough to stow the entire cable, which will be about 2,000 miles long, and the process of laying it will include the dropping of about 400 miles of cable on one side of the Atlantic, then the placing of another 400 miles on the other, and finally the picking up of both portions with the main part. The new cable was made by Siemens Bros. & Co., limited, of London, who have a process for which they claim great improvements over previous systems. They have promised the Commercial Cable company, it is said, that this cable will afford 33⅓ per cent. in improvement in speed over any cable the company now has in use.

While the contractor is a London firm, a very large proportion of the copper used in construction will be furnished by the Messrs. Roebling of Trenton, N. J. There will be 500 pounds of copper to the nautical mile and 320 pounds of gutta percha, making the cable the largest that has ever been made up to this time. An unusual armor has been put upon this cable to resist the anchors in the fishing grounds of the Nova Scotia coast. Every portion of the cable has been tested with a current of 5,000 volts.

Central Station Business in Chicago.

Probably the condition of the business of the central station companies of the country is the most sensitive barometer of the state of trade in the general electrical industry. It certainly is if the term "central station companies" be considered broad enough to embrace corporations supplying electrical energy for the operation of railroad systems as well as those engaged in the lighting business. As this is the case, it is gratifying to observe that such an important concern as the Chicago Edison company, which operates five central stations in Chicago, and does the lion's share of the business in this city, reports that it is now selling as much current—perhaps a little more—as it has ever done. On April 14th there were connected with its mains arc lamps, motors and incandescent lamps of a capacity equivalent to the energy consumed by 241,741 16 candle power incandescent lamps. As additions to the load are being constantly made, the equivalent of incandescent lamps connected may now be safely placed at 250,000. This is not only a striking demonstration of the electrical development of Chicago, but it is an encouraging indication of a betterment of business conditions, in which the electrical industry is participating.

Incandescent Lamp Litigation.

In the United States Circuit Court at Boston, before Judge Colt, Saturday, April 14th, the General Electric company asked that an injunction be granted, restraining the Boston Incandescent Lamp company from manufacturing incandescent lamps. The lamps manufactured by the Boston Incandescent company do away with the use of leading-in wires, utilizing as conductors, two strips of a finely divided film of silver adhering to the sides of a glass tube, by means of printer's ink which, when the tube is melted and pinched together, oxidizes and disappears. Iron wires are inserted in either end of the tube before it is pinched together, to which the carbon filament and circuit wires are attached. The lamp, the complainant's attorneys claimed, is an all glass chamber, has a vacuum, employs a carbon filament and infringes the second claim of Edison's patent.

Judge Lowell claimed that it did not infringe the patent in that it did not have any leading-in wires sealed in the glass, whereupon it was explained that a wire consisted of a strip of finely divided metal whose separate molecules are held together by a cohesive force, inferring that the only difference between the wire and the finely divided film was in the distance between the molecules. It was also claimed by the plaintiff that, according to Prof. Cross, there was nothing new or novel in using a finely divided film to transmit a current of electricity, it having been known as early as 1861, as well as the knowledge of the proper amount necessary to replace a given size of wire and its co-efficient of expansion. While, according to the affidavit of Prof. Walsh for the defense, it was claimed that the process of commercially leading the current into the lamp by means of a strip of finely divided metal was new, ingenious and pretty from a scientific point of view. The defense gave figures claiming a great saving in expense in using the finely divided silver over the use of platinum to meet the affidavits of the plaintiff, which claimed the divided silver to be more costly. The court took the case under advisement.

In the United States Circuit Court at Boston before Judge Colt on April 14th the General Electric company, represented by Mr. Fish, brought action against the Davis Lamp company for contempt. The Davis company not long ago was shut up by the General Electric company, and in order to carry on its repair business and not infringe the Edison patent it sealed into the top of the lamp a small piece of platinum so that it would not be an all glass

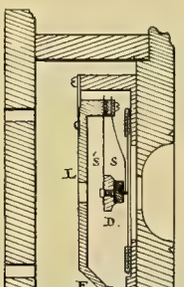


FIG. 2. INVENTION AND DEVELOPMENT OF THE TELEPHONE.—SECTION OF BLAKE TRANSMITTER: D, DIAPHRAGM; S', CARBON SPRING; S, PLATINUM SPRING; L, IRON BRACKET; F, ADJUSTING SCREW.

chamber. The court declared this to be unlawful, and warned the Davis company not to continue the practice.

Units of Electrical Measure.

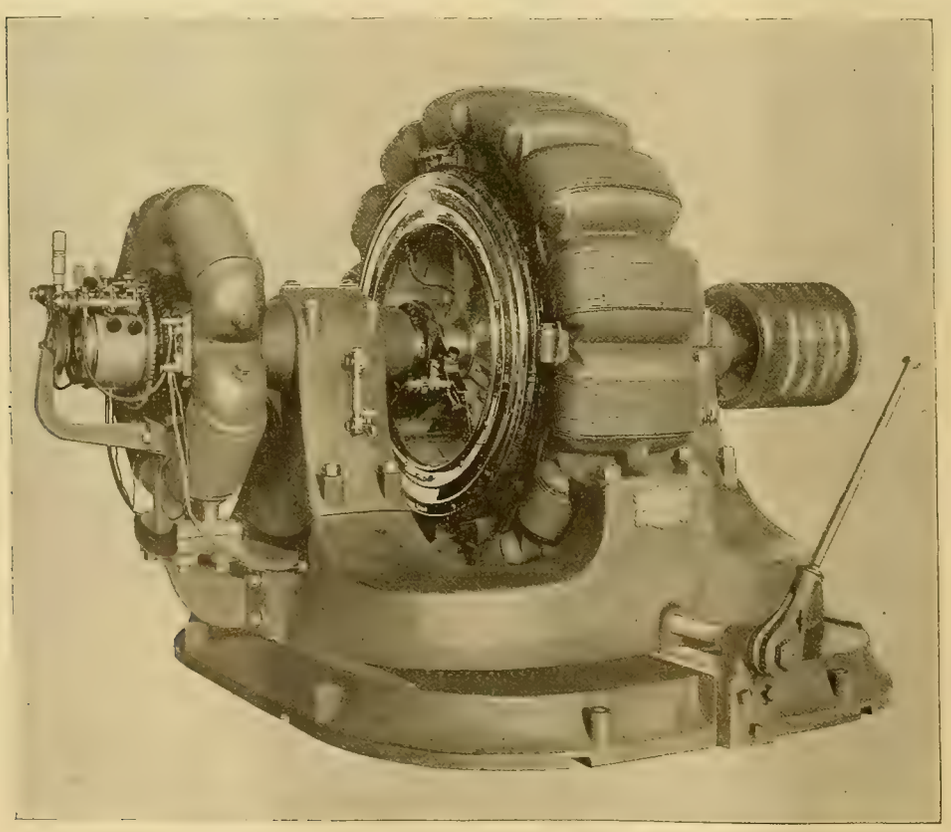
T. C. Mendenhall, superintendent of the United States Coast and Geodetic Survey and of Standard Weights and Measures submitted the report of the chamber of delegates of the International Congress of Electricians held at Chicago last summer to Secretary of the Treasury Carlisle. Having secured his approval an effort is now being made to secure the adoption of the report by the United States government. Mr. Mendenhall announces the formal adoption by the Office of Standard Weights and Measures, of the names and values of units of electrical measure as reported, the same being in accord with the recommendations of the International Congress of Electricians of 1893.

The new Calumet club house on the corner of Michigan avenue and Twentieth street, Chicago, is being wired for 1,400 incandescent lights. Current will be supplied from the Twenty-seventh street Edison station.

Standard Alternating Current Lighting System.

The Standard Electric company of Chicago has placed upon the market its new alternating current system, which embraces alternating machines from 27 to 137 kilowatts capacity. The generator as shown in the accompanying cut has a capacity of 1,250 lights, and operates at a potential of 1,100 or 2,200 volts. The machine has 14 poles, run at 1,070 revolutions per minute, and gives a periodicity of 125 per second. It is the result of a year's experiment and development upon the part of the Standard company's consulting electrician, C. E. Woods.

The general lines of the machine mechanically are identical with the company's series arc light dynamo and constant potential direct current multipolar generators. The general features, electrically, are similar, all the machines being of a consequent pole type of field and ring armature. The spherical winding of the fields of the machine illustrated admits of free ventilation of the armature, and, at the same time, it is claimed, removes them from any inductive influence from the armature. By this design the poles are much shorter, giving a shorter magnetic circuit, and a gross weight in the machine of about two-thirds of the usual type for the same output. The armature is of the surface drum-wound type, the two halves of the armature being in parallel. The spider construction of the armature has been especially designed for rigidity, and gives a form of ventilation that has long been recognized as desirable. From the illustration it will be noticed that this machine is entirely self-contained, the exciter being part of the generator proper, inasmuch as it is on the same shaft as the alternating armature, the fields being supported around this by a brass bracket fastened to the base of the alternator. The exciter is a small multipolar machine with a cross connected armature, thus using only two sets of brushes at 90 degrees apart on the upper side of the commutator. The machine is furnished with self-oiling bearings of the universal ball bearing pattern, using two rings for conveying the oil from the reservoir to the shaft above. A glass oil gauge is attached to each journal protected by a brass shield to keep the glass from being broken, with a cock inserted in the bottom for drawing off oil when necessary. The journal is mounted on an iron sub-base provided with a right and left hand ratchet, which can be attached to either end of the machine as desired. Mr. Woods has also provided in connection with this line of alternating machines a new type of transformer, the principal features of which are that it is fire-proof inside and water-proof outside,

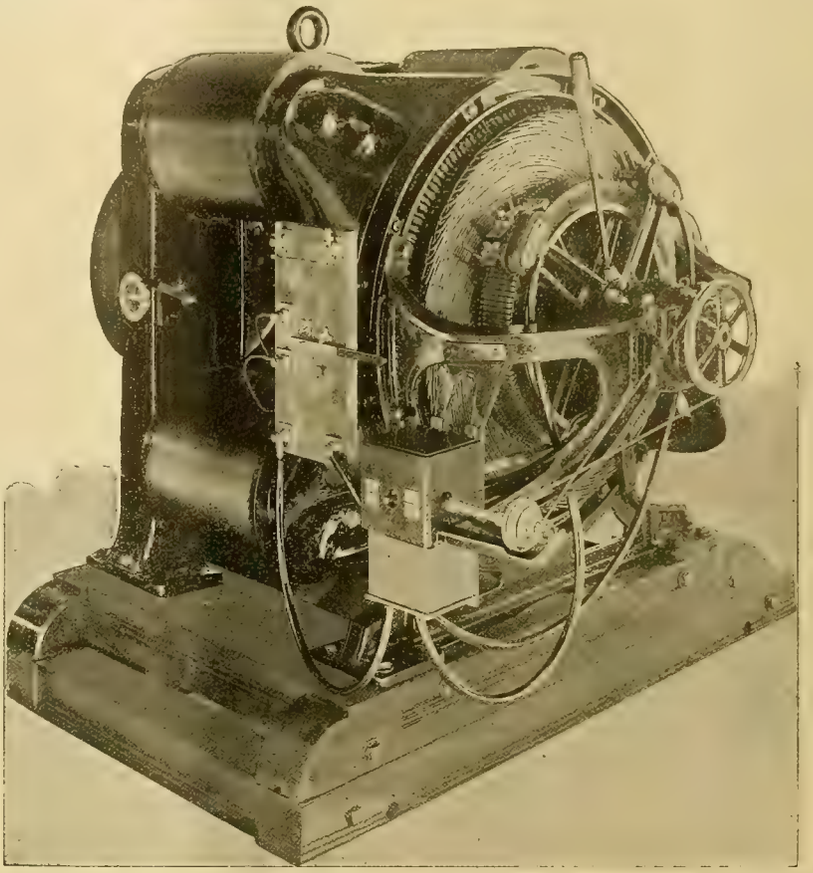


STANDARD ALTERNATING CURRENT LIGHTING SYSTEM.

and provided with an entirely new form of fusing device. He has also for use on this system a complete line of instruments embracing voltmeters ampere-meters and ground-detectors, which are all of an entirely new form of construction and principle in design.

Western Electric Dynamos for Detroit.

The Western Electric company, Chicago, recently closed a contract with the public lighting commission of the city of Detroit for eighteen 100 arc light dynamos, and these machines are now in process of construction.



WESTERN ELECTRIC DYNAMOS FOR DETROIT.

The specifications for these machines were unusually severe, and a thorough test made at the factory of the Western Electric company a few weeks ago by disinterested experts showed that the machines were far in excess of the requirements of the specifications. The design of the dynamos, as shown in the accompanying illustration, is new and embodies a number of improvements which are of considerable merit.

The municipal electric light plant, which is being erected under the supervision of the electric lighting commission in Detroit, has been a bone of contention for the last six months. Matters progressed favorably until it came to the point where the contract for the electrical machinery was to be let, at which time the city council aspired to dictate to the electric lighting commission and refused to confirm the contract. It is said that the common council has decided that the city council had no authority in the matter, and the commission is going ahead with the work. Ground has been broken for the power house, which will be located in Atwater street, near Bates. Two thousand spiles will be driven for the foundation. The plant will have a 10 inch concrete floor. The building will be 150 by 136 feet wide and two stories high. The plant will consist of eighteen of the Western Electric company's arc machines, seven Peck double-deck, down draft boilers, furnished by C. C. Peck, Rochester, N. Y., and five marine type, triple expansion engines, made by S. F. Hodge & Co. of Detroit. The plant will run 1,500 of the new Brush-Adams arc lamps at the start, which the Brush Electric company of Cleveland, O., will furnish. Alexander Dow, the city electrician, is investigating the merits of several incandescent machines, as the commission is also figuring on running an incandescent plant. The arc lighting plant is expected to be completed next fall.

In the 100 light machine of the Western Electric company the magnetic field is arranged with four poles, alternately north and south, in symmetrical relation with the armature, the excitation being effected by four coils connected in series included directly in the circuit of the dynamo. The armature is of the ring type, having a large number of small coils with a series group system of connections. The commutator is large, has ample air space between segments, removable segments, carbon brushes, and fireproof insulation. At a speed of 500 revolutions per minute, the dynamo will supply 100 lamps on a circuit twenty miles in length, maintaining a current of 9.6 amperes, and while so operating may be instantly short circuited, or the circuit opened without injury to the machine. Extreme and sudden changes in the number of lamps do not endanger the machine nor cause troublesome interruptions in the action, and the machine will operate on any load from zero to maximum with very moderate heating and with great stability and steadiness, no injurious sparking at the commutator occuring under any condition of load. No lubricant or blowout device is required on the commutator, and but little attention to keep it in proper working condition, as no destructive flashing takes place under any circumstances. The bearings of the armature shaft are self-oiling and self-aligning, of ample proportions and best material. Gauges are provided which enable the attendant to observe the height of the oil in the reservoirs at all times. As a particularly desirable feature, attention is called to the very compact form of this ma-

chine, the small floor space required, and to the fact that notwithstanding its compactness great accessibility of parts and ease of removal is secured, while the machine is adapted to be directly connected to a high speed engine or driven by belt.

Chicago Interests of the General Electric Company.

An interior view of the new Chicago offices of the General Electric company on the tenth floor of the Monadnock

FIG. 1. CHICAGO INTERESTS OF THE GENERAL ELECTRIC COMPANY —THE NEW OFFICES.

block is shown by Fig. 1 of the accompanying pictures. The removal from the old building at 173 and 175 Adams street was accomplished nearly two months ago, and the electrical fraternity of Chicago has now become accustomed to the change. The Monadnock, seventeen stories high, rears its huge outline on Jackson, Dearborn and Van Buren streets, and is one of the largest office buildings in Chicago. It has become quite an electrical center, containing the offices of a larger proportion of the electrical concerns of Chicago than any other building. The rooms occupied by the General Electric company, 1042

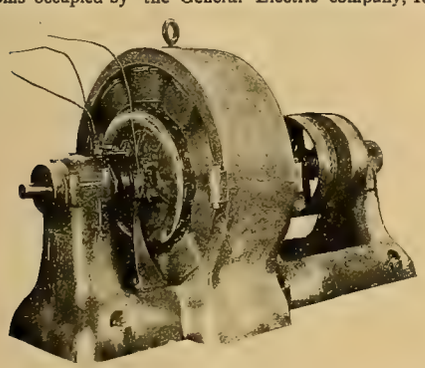


FIG. 1. THREE-PHASE APPARATUS OF THE GENERAL ELECTRIC COMPANY.

to 1056 inclusive, take up the whole of the southern end of the tenth floor and are fitted up handsomely, so that the company has one of the finest suites in the building. Entering the offices from the hall, the accounting department, credit department and cashier are on the right; on the left are General Manager Sunny's office and the telegraph and telephone operators. A railing separates the hall from the main office, in which are located the salesmen, purchasing agent, engineers, etc. The departments —railway, under Theodore P. Bailey; power and mining, under W. F. White; lighting, under J. W. Johnson, and supplies, under P. J. McFadden—are on the eastern and southern sides of the building in separate offices. The rooms are light and airy, and the arrangement is very compact and convenient.

The large, new Chicago warehouse of the General Electric company is illustrated in Fig. 2. It is located on the West Side, on the line of the Wisconsin Central, Chicago & Great Western and Baltimore & Ohio tracks, and is entirely devoted to the use of the company. It contains a large stock of electrical machinery and merchandise, and considerable space is devoted to the repair shop. The shipping facilities could hardly be improved. The

FIG. 2. CHICAGO INTERESTS OF THE GENERAL ELECTRIC COMPANY.—WAREHOUSE AND REPAIR SHOP.

offices and warehouse are connected by private telephone lines, and prompt fulfillment of orders is insured.

The Association of Practical Electricians, Chicago, has been incorporated. The incorporators are George E. Sandford, G. H. Jacob and J. L. Hagardorn.

Three-phase Apparatus of the General Electric Company.

The apparatus employed by the General Electric company in its three-phase power transmission work has all been designed with a view to obtain high commercial efficiency and close regulation. The accompanying illustrations show a 300 kilowatt three-phase generator and a 15 horse power three-phase induction motor. In the generator, Fig. 1, the armature and field coils are all highly insulated, so that the danger of accidents is reduced to a minimum, and fairly high voltages may be used with the certainty of obtaining a thoroughly reliable machine. The bearings are self-aligning and self-oiling, and the armature being carefully balanced upon rigid supports, the machines run with scarcely a tremor. The magnetic circuit and the windings are so proportioned that the machines run exceptionally cool and require little or no attention to the rheostat, even under considerable changes of load. In the large, direct-driven machines, and in

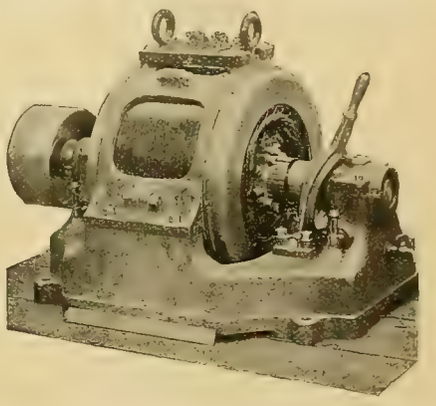


FIG. 2. THREE-PHASE APPARATUS OF THE GENERAL ELECTRIC COMPANY.

all cases in which light weight is essential, the magnetic circuit, aside from the armature, is composed of cast steel. The standard periodicity employed is 60 cycles per second, 7,200 alternations per minute. This is sufficiently high to permit the ready use of incandescent and arc lamps and the employment of all standard transformers. It is also low enough to permit the use of induction motors under the most advantageous conditions, and to avoid trouble from self-induction and capacity effects on the line except at very great distances.

Certain of these machines are arranged to run at 33 cycles, which periodicity is that adopted for very long work, in order to reduce the induction and capacity effect on the line, and in plants where the use of rotary three-phase continuous current converters is of prime importance. All of these three-phase generators can be arranged for direct driving from Pelton wheels,

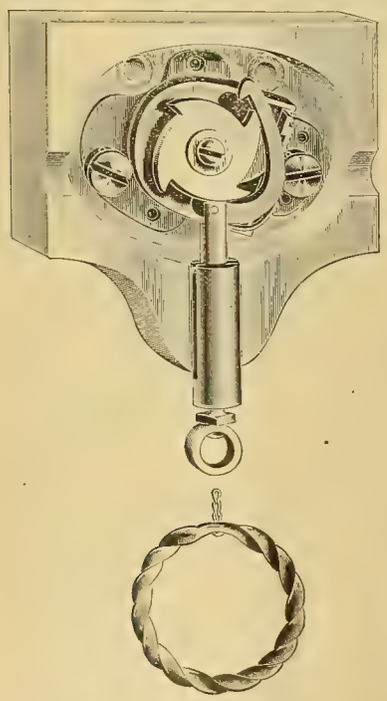
and the larger units lend themselves with facility to direct coupling to turbines. They have an efficiency of at least 90 per cent., rising to 95 per cent. in the largest sizes. With slight changes they can be used as self-starting synchronous motors. They come up to speed under light loads without the intervention of clutches or starting motors. They are fully as efficient as the generators, run in absolute synchronism with them, even under heavy overload. Synchronous motors are of especial value in power transmission, as by strengthening their fields it is possible to compensate for loss of voltage due to induction in the line.

In Fig. 2 is show a General Electric 15 horse power three-phase induction motor. These motors are substantially equal to good shunt wound motors, but have no moving contacts, the only connection with outside circuits being through the three binding posts on the top of the motor. The magnetic part of the field and armature is constructed of annealed laminated iron. The current from the outside circuit passes through windings imbedded in the stationary field punching. The winding of the armature has no connection with the electric circuit, but is short-circuited on itself through a small number of heavy copper bars united at the ends by connectors. It is furnished with a starting resistance placed within the armature spider. At starting, a sliding collar along the shaft is kept out of contact with the switch serving to short-circuit the resistance. When the motor is nearly at speed the contact ring is slid along the shaft, engages the switch points and short-circuits the armature. This renders possible a large starting effort with a current limited by the resistance, which is so adjusted as to give a starting torque equal to the running torque at full load with somewhat less than the full load running current.

The massive character of the armature winding, in which the electromotive force is only from 10 to 25 volts, renders burnouts almost impossible, and the absence of commutators and collecting rings obviates the danger of sparking. It is claimed that these induction motors are electrically equal to direct current machines of the same capacity. They are recommended for all units below 100 horse power, above which synchronous motors would be preferable.

Bryant Chandelier Pull Switch.

The latest specialty placed upon the market by the Bryant Electric company is a chandelier pull switch, which is



BRYANT CHANDELIER PULL SWITCH.

illustrated in the accompanying figure. Its capacity is five amperes and it is single pole. The switch is encased in a porcelain block and can be placed either in the canopy at the ceiling or in an ornamental ball, such as is found on some chandeliers at the base. The operating of the switch is done by means of a ring and chain, one pull turning on the lights, the next turning them off. The switch is well made and bids fair to meet with popular favor.

As an evidence of how the hard times have affected the business of some electric lighting companies, the decrease in the business of the Denver, Colo., Electric Light company is of interest. On July 1, 1893, the company was supplying current to 1,700 arc lamps; on January 1, 1894, only 841 lamps were in circuit; and on February 1, 1894, the number had decreased to 800.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 23.—The future of the rapid transit bills now before the Legislature hardly seems more bright than it did a week ago. Genuine opposition has been encountered by the bill fostered by the Chamber of Commerce, and grave doubts are now entertained as to its ultimate passage. Much complaint has been made of the persistent and open lobbying which is being done by what are said to be the representatives of elevated railroad interests in New York city. The Albany dispatch to the *Times* of April 18th says:

Unless Speaker Malby and Lieutenant-governor Sheehan crush the lobby and drive its representatives from the floor the Chamber of Commerce rapid transit bill will be beaten before the Legislature reads it. A more brazen and audacious exhibition on the part of the lobby has not been seen within the past decade.

The bill was advanced to its third reading in the Assembly last Tuesday, and on Friday the Senate reported it, as well as the Butts-Lueow bill, both amended to provide for non-partisan commissions. These bills legislate out of office the present rapid transit commissioners, and provide for the appointment of a new board. They also provide that the new board of rapid transit commissioners shall devise plans for a complete rapid transit system, and that it shall ascertain the cost of the system. The question is to be submitted to the people of New York next fall in order to determine whether it is the popular idea to build the road at the expense of the city. These bills will be a special order for to-morrow's session. By reporting both bills the Senate committee on railroads avoided the responsibility of choosing between them and further complicated the question, as it will come up before the Senate in such a way as to make final action more difficult than if only one bill were to be considered. To-morrow should be an important day to promotors of rapid transit.

Last Friday the bill proposed by Mr. Gerst of Erie, reducing the telephone rates in the cities of the state was lost by a vote which showed very plainly that the eventual outcome of the bill was at no time in serious doubt. It was known that both political parties were opposed to the bill and it is not likely that any further agitation will be started upon the subject.

It appears from the facts that have recently been brought to light that there is a claimant for the honor of being the first man to build an electric car in the person of Dr. Gardner Quincy Colton of New York. Dr Colton has upon exhibition in his dental rooms in Cooper Union, an electrical locomotive about a foot long, which he states he built in 1847, with the idea of drawing a toy passenger car around a circular track. It is run by an ordinary cell battery, which is on the floor, under the circular track, and the electric currents are conveyed through wires to the insulated brass bands which form the rails of the track. The wheels of the locomotive convey the electric currents to two electro-magnets, which act alternately in moving the driving rod of the engine, an eccentric projection on the crank serving the currents to each magnet in turn. Dr. Colton invented the locomotive but never thought of getting a patent upon it. The locomotive was exhibited in Cincinnati, St. Louis, Memphis, New Orleans, Mobile and in several large towns in New England in the course of a series of lectures that Dr. Colton delivered, at the conclusion of which it was placed in a trunk and forgotten for many years. About a year ago, when a suit was begun in Chicago to test the validity of a patent for an electrical railway, one of the lawyers interested in the case sought out Dr. Colton and made inquiries about the little locomotive, declaring that the publication of Dr. Colton's invention forty-seven years ago was sufficient to make the patent invalid. It was a long time before Dr. Colton could find the old toy, but he made inquiries among his relatives, and at length the engine was found in the garret of a house in Vermont which is the home of a daughter of Dr. Colton's sister. Lately Dr. Colton was called as a witness before a referee in the patent suit, and the locomotive which he had invented and exhibited in 1847 was photographed. It works well now, although its appearance proves its age.

The campaign against overhead wires which the city authorities are now conducting has been carried into Wall street. About 150 wires were cut by the linemen upon the street.

W. F. O.

Detroit, Mich.

DETROIT, April 21.—Cameron & Gillett, contractors for electrical construction work, have opened an office at 49 Wilcox street, and are rushed with orders. Mr. Cameron is well known in electrical circles through his connection with the Detroit Electrical Works. Among the recent contracts which this firm has secured are a complete plant for the ferry boat Pleasure, operated by the Windsor Ferry company, and a 500 light plant for Farrand, Williams & Clark. Cameron & Gillett have also installed a plant for the Hincheman Drug company. This plant is operated by an Otto gas engine furnished by Schoonmaker Bros., the local representatives.

Brownlee & Co., well-known dealers in cedar and pine telegraph and street railway poles, report that they have done 50 per cent. more business this year than they did during the corresponding period last year. This is probably due to their increased facilities for manufacturing poles, cross-arms, etc., which enable them to make better prices. Among the orders which Brownlee & Co. have received within the last week are the following named: One for 600 octagonal pine poles from the Dayton, O., City Railway company; one for 275 octagonal pine poles to be shipped to the Alleghany Traction company, Alleghany, Pa., and another for 100 poles for the Lafayette Street Railway company, Lafayette, Ind.

The Detroit Dynamo company has installed 120 horse power in motors and generator in the foundry of the Ideal Manufacturing company, Detroit. This is the only electrically operated foundry in the city.

The public lighting commission has decided to purchase the lighting towers from the Detroit Electric Light & Power company, together with all the material in that company's plant which can be used in the municipal plant.

Among the recent sales of the Detroit Motor company may be mentioned the following: One 25 horse power generator of 300 lights' capacity to the park commissioners for lighting Belle Isle Park; two 25 kilowatt dynamos of 800 lights' capacity for the Home Savings Bank building, and one generator of 500 lights' capacity, to Farrand, Williams & Clark.

F.

PERSONAL.

F. W. Cushing, Chicago, left for Europe Monday. Mr. Cushing will represent the Gray telautograph interests in England and France.

Thomas J. Duncan, formerly with William Cramp's Sons and the Langhome, Pa., Electric Light company, has accepted the position of superintendent of the Haddonfield, N. J., Electric Light & Power company.

P. J. McFadden, formerly in charge of the meter department of the Chicago office of the General Electric company, has been made manager of the entire supply department, which now includes meters. A. M. Searles, who has hitherto looked after the interests of the supply department, will engage in other work for the company.

Wells Goodhue, the well-known electrical specialist, of Chicago, lectured on Friday evening, April 20, at the La Salle Institute, Wabash and 35th street, on "Hawaii and Her Troubles." Mr. Goodhue showed a thorough knowledge of his subject and delivered a most entertaining lecture. G. W. Conover managed the stereopticon. The entertainment was under the auspices of Brother Adjutor, president of the La Salle Institute.

NEW INCORPORATIONS.

Taylor-Belding Electric company, Chicago; capital stock, $10,000; Charles H. Taylor, Chicago, Ill.

ELECTRIC LIGHTING.

An electric lighting plant is being installed by the town of Globe, A. T.

Oxford, Ind., will own its electric light plant, and the streets will be illuminated by arc lights.

The authorities of Seattle, Wash., are discontinuing the use of incandescent electric lamps as rapidly as possible, and arc lamps are being substituted.

An isolated plant consisting of a 30 kilowatt Edison dynamo directly connected to a Ball engine has been installed in the Industrial Home for the Blind, Chicago.

A consolidation of the gas and electric lighting interests of Eureka, Cal., has been perfected, and the combined enterprises will be hereafter known as the Eureka Lighting company.

The fine new steamer, Northwest, of the Great Northern line on the great lakes, has been equipped with a 36-inch searchlight projector, which was exhibited at the World's Fair.

ELECTRIC RAILWAYS.

Citizens of Sanilac Center and Carsonville, Mich., are trying to raise enough money to build and operate an electric road between the two towns, a distance of eight miles.

The Toledo, Monroe & Detroit Electric Railway company has succeeded in obtaining a franchise through Monroe, Mich., after several vain attempts. The road, extending from Toledo to Detroit, is to be completed within eighteen months.

A deed of trust on first mortgage gold bonds for $650,000 to the Illinois Trust & Savings bank was placed on file April 6th by the Chicago-North Shore Street Railway company. The deed is under date of March 15th, and is for eighteen years, expiring April 1, 1912. It is to cover

bonds already issued to the amount of $650,000 and future issues to aggregate not over $1,500,000. The mortgage covers all property, including real estate, rolling stock, tracks, stock, etc., now owned, or that may in future be acquired by the railway company.

MISCELLANEOUS.

The last issue of the *Journal of the Franklin Institute* announces the award of the Elliott Cresson medal to Nikola Tesla for researches and discoveries in high frequency phenomena.

It is reported that Siemens & Halske are experimenting with an electric plow on the estate of Biesdorf, the property of Arnold von Siemens. A great success is looked for with the electric plow in Java, where large tracts of land lie fallow in consequence of the distruction of draught animals by the cattle plague.

The last issue of the constitutions by-laws and list of members of the Western Society of Engineers, with rooms at 51 Lakeside building, Chicago, shows the society to be in a prosperous condition. The officers for 1894 are as follows: President, H. B. Herr; vice-presidents, D. W. Mead and H. C. Draper; secretary and librarian, Thomas Appleton; treasurer, David L. Barnes.

The Montreal Electric club has been interesting itself in the interior wiring problem and has adopted and recommended to the architects of the city a set of rules, by the observance of which, it is hoped, that a reform in this line of work may be effected. The rules have been approved by the city electrician, and if their rigid enforcement is observed, there will be small room for future complaints.

TRADE NEWS.

The Sunbeam Lamp Manufacturing company of Chicago is permanently located in the Chicago Title & Trust building, 100 Washington street.

The Fontaine Crossing & Electrical company Detroit, is having an excellent demand for its incandescent machine, and has filled a number of large orders of late. Mr. Roberts, the manager of the company, considers the outlook for business very good.

The Western Telephone company, Monadnock building, Chicago, has installed a station of 50 instruments with all necessary appliances, in Russellville, Ky. The company is also constructing a fine private telephone exchange for the Johnson company of Johnstown, Pa.

The Rue Manufacturing company, 116 North Ninth street, Philadelphia, manufacturer of injectors, ejectors and other jet apparatus, has issued a comprehensive, illustrated catalogue describing the machinery of which the company makes a specialty. Full directions are given for the setting up and installation of the apparatus.

The Perkins Electric Switch manufacturing company, Hartford, Conn., is sending to the trade an illustrated price list of such goods as the company manufactures itself and for which it has secured United States letters patent. Single pole, double pole and various forms of flush switches are described as well as different forms of sockets, arc lamps, etc.

The Dayton Globe Iron Works company, manufacturer of the new American turbine water wheel, rag engines and pulp grinders, Dayton, O., has issued a new catalogue which contains lists of gearing, shafting, pulleys, couplings, journal boxes—in fact a full line of power transmitting machinery of which the company makes a specialty. It is fully illustrated and well arranged.

Under the title of "More Light on the Subject," the Southern Electrical Manufacturing & Supply company, New Orleans, La., has issued a book containing a list of the electric plants it has installed and a number of testimonial letters which it has received. Judging from this work the company must be in a condition of prosperity, for the list is long and the letters are many.

The Mica Insulator company, 218 Water street, New York, is pushing the sales of the micanite insulator in every direction. Micanite is made of pure India sheet mica. It does not absorb oil or moisture. Its mechanical and electrical durability is pronounced, and it is equal in efficiency to India sheet mica. One of its special applications is in its use in rheostat boxes. It is giving excellent satisfaction in such service.

The Blair Lamp Adjuster company, Omaha, Neb., is sending to the trade a pamphlet of testimonials received, testifying as to the operation of the Blair lamp adjuster. This device is easily attached to the ceiling and remains stationary. It will not get out of order and will take up eight feet of cord. The company claims that it meets all the requirements of the Fire Underwriters' association. The office of the company is in Omaha, Neb.

The General Electric company has just issued a handsome souvenir, which will be appreciated by business men. It is a date book gotten up in the form of a double indexed diary. The book is handsomely bound and on the outside front cover are the words: "With the compliments of the General Electric company." It will be a daily reminder to every one who is so fortunate as to receive one of the company, and in this way will no doubt prove a very valuable advertisement.

The Massachusetts Institute of Technology, Boston, has issued its annual catalogue for 1893–1894. The book contains a register of graduates, register of students, schedule of topics, a chapter on the subjects and methods of instruction, the courses of instruction and the requirements for admission. The course in electrical engineering is made prominent. It is designed to meet the needs of young men desirous of entering upon the practice of any of the various applications of electricity in the arts. Its leading studies are physics, especially theoretical and applied electricity, mechanical engineering and mathematics.

N. I. R. wire is being put into the Leland Hotel at the corner of Jackson street and Michigan avenue, Chicago. This wire is becoming prominently known in the West, and some of the largest buildings in Chicago have been wired with it. The Metropolitan Electric company is the general western agent and carries a complete stock. The company reports a large trade in porcelain goods, especially tubing for joists. Varying lengths, up to 40 inches, are carried in stock to meet the demands of the trade. The Stock Exchange building is the latest to adopt Xutric switches throughout. The Old Colony building has these switches also, and they are found to be entirely satisfactory. The Metropolitan Electric company feels the preference as being very important, when it is considered that the Xutric switch has only recently been put upon the market.

Wells Goodhue, 1564 Monadnock building, Chicago, general northwestern agent for the Wagner transformer, is distributing a book illustrating and describing the transformer, which will be of interest to electric lighting men in general. The Wagner transformer is the result of several years' experience in the use of transformers in one of the largest existing stations and is a most successful effort to obtain results calculated to be superior to those found in common practice and to avoid the most objectionable features inherent in apparatus which has been made familiar. High and practically indestructible insulation is used throughout in the construction of the Wagner transformer, and much attention is paid to the subject of regulation. The Wagner Electric Manufacturing company has designed numerous types and styles of its specialty and this book pays each style its due amount of attention.

The latest catalogue of Replogle's electric water-wheel governors manufactured by H. E. Olbrich, Cedar Falls, Ia., is exhaustive in its reading matter and contains illustrations which properly exemplify the machinery. The electric governor consists of a regulator, a high-speed engine governor, and a gravity battery with its circuit. The regulator is powerful enough to control the water-wheel gates, and receives its power directly from the wheel. It is also so sensitive that the battery current will cause it to move the gates. The engine governor is simply used as an indicator, and as the pointer rises or falls it makes an electric contact, telegraphing the regulator which way to move the gates. The compound regulators are practically several regulators combined in one machine and arranged to be called into action at different variations of speed, so that a faster gate motion may be had automatically when necessity requires. By means of switches perfect control of gates may be had from any point in or out of plant or factory.

One of the neatest and best arranged catalogues issued lately is that of the India Rubber & Gutta Percha Insulating company, whose New York office is at 315 Madison avenue. The general manager, W. M. Habirshaw, is giving this book an extensive circulation. It treats of the Habirshaw insulated wires and cables for electric lighting, electric railways and for all telephones, telegraph and mining purposes. One of the novel features of the book and one which must be commended, is the idea of indexing it for the parts into which it is naturally divided. This is undoubtedly of great advantage in a work of this kind and of much convenience to readers Particular attention is called to the fact that the contents of the catalogue have been copyrighted and that the company is determined to protect its rights. The book contains many valuable tables and interesting illustrations, and it is hoped by securing a copyright to protect them from promiscuous reproduction. The book is without question one of the most complete ever issued by a wire firm.

The United Co'umbian Electric company, 280 Broadway, New York, manufacturer of electric railway and power apparatus, is calling attention to its improved twin series railway motor in an illustrated hand book. The contents of the book describe in detail the construction of the motor and its accessories, as well as the advantage to be gained by its use. In this type of motor the heating of armatures and fields is reduced to a minimum, and perfect protection is provided against the weather. Mechanical strength has been given much attention, and great care has been taken to prevent any possible shifting or change in the centers, or any throwing out of line. The circular form of the steel arms, which are part of the field castings, preserves absolute rigidity between the armature shafts and the axles of the truck, at the same time the ingenious flexible joint preserves the freedom between the two axles necessary for easy riding around curves or over an uneven track. The details of interesting tests made upon the line of the Union Railway company, New York city, February 21, 1894, are embodied in the book.

The Link-Belt Machinery company, Chicago, has issued a special catalogue of mining machinery for 1894. The book was compiled by O. W. Russell, the company's advertising manager, and its appearance reflects a great deal of credit upon its compiler. The company manufactures special lines of machinery for mines, concentrating mills, smelters, collieries, gravel and clay pits, quarries, etc. It also designs and erects elevators and conveyors for handling ore of all kinds, coal, stone, lime, earth, gravel, sand, coke, etc. Many interesting installations of the machinery used for these purposes are illustrated in this catalogue as well as the construction in detail of the company's machinery. Considerable attention is given to different types of elevators, the link-belt, perfect discharge, gravity discharge, continuous bucket elevators, all being illustrated and described. There is an endless number of applications to which the machinery of which this book treats may be applied, and it should be given consideration by those interested. The sales office of the company is at 21 and 23 South Jefferson street, Chicago, and the general office and works at Thirty-ninth street and Stewart avenue.

BUSINESS.

After May 1st the office of the Fibre Conduit company will be in the Home Life Insurance building, 257 Broadway, New York.

Stanley Green, western manager of the Green Fuel Economizer company of Matteawan, N. Y., has closed an order for 1,000 horse power boiler economizers for the Montreal cotton mills.

The Chicago Insulated Wire company, Chicago, has removed its offices from 207 South Canal street to larger and more commodious quarters in rooms 414 and 416 Northern building, corner of Lake and La Salle streets.

William H. Bryan, mechanical and electrical engineer, Turner building, St. Louis, reports the indications of a very busy season. Mr. Bryan has added to his force in what appears to be a vain effort to keep up with the work.

A. L. Ide & Son, manufacturers of the Ideal engine, report a large number of recent sales, including engines in St. Louis, Chicago, Detroit, Leadville, Peoria, Rutland, Vt., Tuscon, Ariz., Franklin, Mo., Monett, Mo., Waseca, Minn., and Wayne, Mich.

J. E. Ham, general agent for Day's Kerite, spent several days in Chicago last week. Mr. Ham returned to New York highly pleased with the large volume of business done by Cushing & Morse, the western agents, and with the successful standing of the firm.

Despite the recent financial stringency the Chicago Rawhide Manufacturing company, 75 East Ohio street, Chicago, has received orders for its high grade rawhide dynamo belts right along, and has, at times, been compelled to work overtime in order to meet the demand.

C. E. Woodruff & Co., 235 East Lake street, Chicago, western agents for the American Circular Loom company's new conduit, are doing a very satisfactory business. Their sales have increased in an encouraging manner during the last few weeks, and they report the outlook to be particularly bright.

J. S. Stephens has opened an office at 1427 Manhattan building, Chicago, for the Russell Engine company, as its western representative. The engine field is a wide one and with the extensive projected enterprises in electrical matters in the West Mr. Stephens will undoubtedly make a good showing with the Russell engines.

The Bryant Electric company makes double pole switches of five, 10, 15, 25 40 and 50 ampere capacity. Its western office, managed by Thos. G. Grier and Edward R. Grier, keeps a complete stock on hand. This office will be moved on May 1st from the present location, 1522 Monadnock building to 1532 in the same building. The two store rooms will not be changed. The double pole switch illustrated last week was of five amperes capacity.

"Not 'good' but the best" is the phrase which the Sunbeam Lamp Manufacturing company has adopted as its own when calling attention to the Sunbeam incandescent lamp. The company is making every effort to impress the trade that a lamp cannot be cheap unless it is good. The Chicago selling agent for the Sunbeam lamp is the Wallace Electric company, 307 Dearborn street.

W. D. Ball, consulting electrical engineer, 1627 Monadnock building, Chicago, reports that he is now prepared to do all kinds of laboratory work, testing insulation resistances, magnetic qualities of iron, all classes of electrical machinery, instruments, converters, rheostats, lamps, etc. He has fitted up his laboratory with a thorough equipment for the most accurate and precise work.

Under the title of "Seasonable Suggestions" the Electric Appliance company, Chicago, has just issued a diminutive literary gem in the shape of an eight page leaflet setting forth the merits and application of its specialty, the swinging ball lightning arrester, and closing with a few pages devoted to the Meston alternating current fan motor. It contains information of interest to every electric light station.

Some few weeks ago the Electric Appliance company, Chicago, announced that it was again prepared to furnish the old reliable Packard lamp as formerly sold. That the trade appreciates what this means is shown by the large lamp orders that have been received on the strength of this announcement. The Electric Appliance company is convinced that there is still a large field for a high grade lamp, even at a comparatively high price.

The General Incandescent Arc Light company, New York, of which S. Bergmann is president, is calling the attention of electric light companies and contractors to the blade switches manufactured by the company. The material and workmanship of these switches are of the best and freely up to the standard of all the work done by this company. In addition to the regular styles the company is prepared to estimate on and furnish special styles and requirements. The Chicago office of this company is at 169 Adams street.

The Stanwood Manufacturing company, 17th and Clark streets, Chicago, devotes a large portion of its large factory to repairing electrical machinery of all kinds, including converters, rheostats, lamps, dynamos, motors, etc., and a specialty is made of rewinding armatures of all systems. The factory is equipped with the latest and most approved tools and machinery for handling this character of work with the greatest despatch. Every effort is made to produce first-class work, and in this particular the company is meeting with considerable success. Earl Atkinson, a mechanical and electrical engineer of long experience, is in charge of this department. He

has been connected with English & Hunter, machinists, of Toronto, the Ball Electric company, and the Delamater Iron Works of New York. He was also foreman and head of a department in the Edison laboratory, and later was with the General Electric company in the West.

J. Holt Gates, general western contractor for the Mather Electric company, reports the sale to the Green Bay, Wis., Electric Railway company of two 175 horse power Mather generators, with marble switchboard and instruments complete. The generators are to be belt-driven by two Ball & Wood simple engines. Mr. Gates has also taken orders for a number of smaller installations in the interest of the Mather company and states that business during the last 30 days has been picking up, and that his company has been securing its full share.

The Hoppes Manufacturing company, Springfield, O., manufacturer of Hoppes' feed-water purifiers, has received the contract for the purifiers, to supply the boilers with pure feed-water, for the new city electric light plant now being built by the public lighting commission of Detroit, Mich. The Hoppes purifiers having been selected after very strong competition. The order calls for seven 300 horse power purifiers to carry 165 pounds of steam working pressure. Each purifier is required to heat and purify 9,000 sounds of boiler feed-water per hour.

The Metropolitan Electric company is offering to the trade a new double pole, horse-shoe cut-out, which has many good points about it and also comes under the new underwriters' rules with regard to covered fuses. The porcelain is moulded in such a manner that the brass pieces to which the wires are attached are counter sunk, so that it is impossible for the canopy cap to short-circuit the wires. The fuses are covered, not by a detachable cap, but are run through a hole in the porcelain which acts as a cover and protects the fuse from outside interference.

The Electric Appliance company, Chicago, has decided now that it can again supply the old reliable Packard lamp, to push its sale to the greatest possible extent, and to better enable it to do so, the company is making arrangements to carry a more extensive stock in Chicago. The stock will be well assorted and complete, ranging in sizes from five to 500 candle power and in quantity sufficiently large to fill almost any kind of an order immediately upon receipt. The company promises to carry the largest and most complete stock of incandescent lamps in Chicago.

Dr. Drysdale of Philadelphia has placed the contract for an iron roof over the new power house for the Hospital for the Insane at Norristown, Pa., with the Berlin Iron Bridge company of East Berlin, Conn. It was desired that the roof be fireproof, and ordinary corrugated iron could not be used on account of the drip. The Berlin Iron Bridge company's patent anti-condensation corrugated iron covering filled the specifications and was adopted. The McNeal Pipe & Foundry company of Burlington, N. J., has placed the contract for two cleaning sheds with the company.

The Central Electric company, Chicago, has closed the doors of its former store upon Franklin street, and has been busily engaged during the last week in moving into the extensive quarters at 173 and 175 Adams street, which is being made ready for the company's reception. Here the Central company will have more room for the carrying on of its large business, and it is safe to presume that some advantageous spot will be reserved for the occupation of the large Okonite sign which has been acting as a sort of a landmark for so long to the travelers in the wholesale district around Franklin street.

The Joseph Dixon Crucible company, Jersey City, N. J., is putting a cycle chain graphite on the market, which for purity of graphite and usefulness is attracting considerable attention. The graphite is not only of the choicest stock, but is ground to an impalpable powder, and then reground with a high grade of lubricating oil. This material, when applied to the chain of a bicycle, penetrates the bearings and thoroughly lubricates and protects them from wear and rust. The Dixon company will shortly put the same material on the market in the form of a solid stick, for the convenience of wheelmen who wish to carry it in their tool bags.

The D'Unger Long Distance Telephone company announces that it is now ready to furnish the D'Unger telephone for use in exchanges. A trying test was made upon this telephone a short time ago at Louisville, Ky. Two instruments were put up in the office of the Louisville District Messenger Service company, and connections for 30 volts made upon each. With this apparatus it is said that a satisfactory conversation was carried througout the entire Postal telegraph system, embracing in extent a territory of 25,000 miles. The test was not made under the auspices of the D'Unger company, but was carried on by experts with the idea of experimenting to determine the distance to which voice vibrations could be transmitted.

An evidence that times are not so deplorable as they are said to be was the satisfactory meeting of the stockholders of the Joseph Dixon Crucible company, held in Jersey City, N. J., April 16th. Out of 7,345 shares 7,215 votes were cast for the same board of managers that has conducted the affairs of the company through its years of prosperity. The vote was the largest ever cast, and it was a decided compliment to the members of the board as were also the remarks of some of the largest stockholders. The board consists of E. F. C. Young, John A. Walker, Daniel T. Hoag, Richard Butler, William Murray, Joseph D. Bedle, Jerome D. Gillett. In the organization of the board E. F. C. Young was elected president, John A. Walker vice-president and treasurer, and George E. Long secretary. The Dixon company was founded by Joseph Dixon in 1827, and organized as a stock company in 1868. Its manufactures are graphite products of all kinds, consisting of plumbago crucibles for melting gold, silver, brass, etc., blacklead retorts, stove polish, graphite for lubricating, electrotypers' graphite, graphite lead pencils, graphite paint, and graphite prepared in hundreds of ways for as many different uses.

The Mather Electric company reports the following sales of apparatus outside of its railway business for the last ten days: Massachusetts Hospital for the insane, Northampton, Mass., one 350 light and one 600 light dynamo; Eastern Yacht club, Boston, Mass., one 250 light dynamo; Wayne County House, Wayne, Mich., two 20 kilowatt direct connected dynamos; S. N. Blake, Elmira, N. Y., one 350 light dynamo; Sherman & Kopf, Detroit, Mich., one 250 light dynamo; George Whitney Woolen company, South Royalston, Mass., one 100 light dynamo; *Syracuse Herald*, Syracuse, N. Y., one 250 light dynamo; Union Central Life Insurance building, Buffalo, N. Y., one 450 light dynamo and one 250 light dynamo; Patent Cereal company, Geneva, N. Y., one 150 light dynamo; Crane Bros., Westfield, Mass., one 50 light dynamo; Henry Reinhardt, New York city, one 150 light dynamo; Boston Ferrule company, East Boston, Mass., one 50 horse power slow speed motor; Phelps Publishing company, Springfield, Mass., one 50 horse power slow speed motor. The Mather company in that time also sold two 15 horse power and a one horse power motor in Springfield and 16 other motors, ranging in capacity from one to 15 horse power, in scattered territories.

While it is not claimed by the Electric Appliance company, Chicago, which is handling the Allen soldering stick, that this specialty is an absolute safe-guard against the troubles which may arise from defective joints on a line, it asserts that its use in the hands of anything like a careful and intelligent workman will greatly lessen the difficulties and practically assure a perfect joint. Its application is so simple and convenient that a lineman can afford to give a little more care and attention to each joint and at the same time accomplish more work than formerly. It is often the case that more soldering salts and acids are wasted than are really used; the bottle is spilled or dropped and broken or the solution is slopped over the joint and about nine parts are wasted. This waste does not take place with the Allen soldering stick, as the stick is simply rubbed on the heated joint, all of the flux adhering to the wire, so that in addition to there being no waste there is no dripping of a destructive acid. The compound is put up in the form of a round stick six inches long and one inch in diameter, and has about the consistency of sealing wax when cold. When rubbed on a heated joint it melts and covers the joint, producing a bright surface, to which the solder adheres with great readiness. Another very important feature is the fact that the Allen soldering stick contains nothing that will in any way corrode the wire or affect the surrounding insulation. It may be said that it is cheap; that it will make a satisfactory and reliable joint electrically; it is a great time saver; it is very convenient to carry around and use; it is always ready for use; is used without danger of injury to the wire or anything near it and without waste. The Electric Appliance company, who is the exclusive manufacturer of the Allen soldering stick, feels confident that it has one of the most desirable specialties that has ever been offered to the electrical trade; and the greatest improvement that has been made in a soldering compound.

ELECTRICAL PATENTS.

Issued April 17, 1894.

518,213. Insulating Turnbuckle. Henry P. Ball, Schenectady, N. Y.

518,214. Ceiling Cleat. Henry P. Ball, Bridgeport, Conn.

518,217. Means for Exciting Field Magnets of Alternating Current Dynamos. Louis Bell, Boston, Mass.

The field magnet coils of the alternating current dynamos have their field magnet coils connected to bus bars, motor-generators being actuated by the alternating currents derived from the dynamos and adapted to deliver continuous currents to the bus bars.

518,218. Regulator for Dynamo-electric Machines. Louis Bell, Boston, Mass.

518,221. Electric Motor Car. Harold P. Brown, New York, N. Y.

518,232. Regulator for Dynamo-electric Machines. William H. Elkins, Cambridge, Mass.

518,236. Rheostat. Jonathan P. B. Fiske, Lynn, Mass.

518,244. Cut-out Meter. Caryl D. Haskins, Lynn, Mass.

518,245. Damping Device for Electrical Measuring Instruments. Frank Holden, Lynn, Mass.

The damping device comprises a drum pivoted to rotate about its axis, and partially filled with a viscous liquid, the inertia of which damps the rotation of the drum upon its axis. The index point is mounted upon the drum.

518,265. Electric Measuring Instrument for Multiphase Systems. Edgar W. Mix, Lynn, Mass.

518,290. Armature for Dynamo-electric Machines. Elihu Thomson, Swampscott, Mass.

518,291. Mode of Cooling Electric Motors. Elihu Thomson, Swampscott, Mass.

518,293. Electric Railway System. Charles D. Tisdale, Boston, Mass.

518,297. Electric Stop Motion. John Weir, Fall River, Mass.

518,310. Universal Phase Alternate Current Motor. Thomas Duncan, Fort Wayne, Ind.

518,311. Electric Meter. Thomas Duncan, Fort Wayne, Ind.

518,312. Armature. Ernst Egger and Ferdinand A. Wessel, New York, N. Y.

518,331. Telephone Exchange System. John I. Sabin and William Hampton, San Francisco, Cal.

The telephone line is normally open at the sub-station, and in circuit with a battery and individual indicator at the central station. The operator by removing his telephone from its hook closes the battery circuit to actuate the indicator and inform the operator of a desire for connection. The operator by inserting her connecting plug cuts out the battery and indicator and loops into a circuit a clearing-out indicator and battery, the indicator remaining actuated by the battery current so long as the operator is in conversation to convey to the operator the information that the subscriber is in conversation. The sub-station bell is included in circuit with a condenser to prevent the completion of the battery circuit through the individual indicator.

518,332. Telephone System. John I. Sabin and William Hampton, San Francisco, Cal.

The telephone line is normally open at the sub-station and in circuit with a battery and indicator at the central station, whereby a call may be sent in by removing the telephone from its hook. The sub-station bell is included in a ground branch from one side of the line, and a generator is provided at the central office adapted to send currents over one limb of the line to ground through the bell.

518,333. Telephone Exchange System. John I. Sabin and William Hampton, San Francisco, Cal.

The telephone line is normally open at the substation and closed through the operator's cap telephone at the central station, so that the subscriber by removing his telephone from its hook closes himself in circuit with the operator. By the insertion of a plug the cap telephone is cut out and a battery and clearing out annunciator are bridged into circuit.

518,334. Telephone Exchange System. John I. Sabin and William Hampton, San Francisco, Cal.

The metallic circuit telephone line is normally in circuit with the operator's cap telephone, which is included in a metallic local circuit adapted to be cut from the line when connection is made at the central office, a battery and clearing-out indicator being by the same act cut into circuit.

518,337. Electric Tower Clock. Charles D. Warner, Ansonia, Conn.

518,345. Controller for Electric Motors. William Cooper, Minneapolis, Minn.

518,357. Automatic Trolley Wire Finder. Theodore Straus, Baltimore, Md.

518,359. Electric Current Regulator. Addison G. Waterhouse, Hartford, Conn.

The method of regulation consists in opposing the flow of the current in either of two branches of a circuit by a current generator, and opposing the flow of current from the generator on short circuit through the branches by the counter-electromotive force of an electrolytic element.

518,360. Method of Regulating Electric Currents. Addison G. Waterhouse, Hartford, Conn.

518,362. Trolley Wheel. John D. Ansley, Cambridge, Mass.

518,365. Rheostat. Alva C. Dinkey, Allegheny county, Pa.

518,392. Telephone Transmitter from Secondary Batteries. John J. Carty, New York, N. Y.

The object of the invention is to connect a number of telephone transmitters in parallel on a circuit supplied by a single battery. The difficulty experienced has been that the change of voltage at the battery, due to the variation of resistance in a branch containing one transmitter, produces a variable current in the induction coils of the other branches, thus actuating all of the receivers. To avoid this the internal resistance of the battery is made very low, so that any change of external resistance will not appreciably change the voltage of the battery, and, in consequence, the remaining branches are not affected by the variation of resistance in one branch, due to the actuation of the transmitter therein.

518,404. Electric Starting Switch. Frederick V. Henshaw, Brooklyn, N. Y.

518,414. Bond for Electric Railways. Julius Meyer, New York, N. Y.

518,444. Dynamo-electric Machine. Henry E. Dikeman, Berkeley, Cal.

518,463. Coin Controlled Electric Machine. Robert J. Merker, Cleveland, O.

518,471. Electric Switch. Joseph B. Smith, Manchester, N. H.

518,481. Electrical Contact Mechanism. John F. Blake, New Haven, Conn.

518,511. Electric Railway Signal. Benjamin F. Rex, St. Louis, Mo.

518,525. Automatic Electric Signaling Device for Crossings. Edward A. Hermann, St. Louis, Mo.

518,534. Electric Current Recorder. Johan W. Th. Oman, New York, N. Y.

518,540. Electric Railway Conduit. Paul P. Banholzer, Philadelphia, Pa.

518,542. Thermo electric Generator. Harry B. Cox, Hartford, Conn.

518,561. Electric Motor. Harold P. Brown, New York, N. Y.

518,562. Armature for Electric Motors. Harold P. Brown, New York, N. Y.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents which expired during the week ending April 17, 1894:

189,714. Electric-magnetic Engines. M. Egger, Mariaschein, Austria.

189,717. District Telegraph Signal Boxes. S. D. Field, San Francisco, Cal.

7,621. Printing Telegraphs. F. L. Pope, Elizabeth, and T. A. Edison, Menlo Park, N. J.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, MAY 5, 1894. No. 18

Well Arranged Central Station Plant.

Although not presenting any particularly new feature in central station practice, the electric lighting plant at Hammond, Ind., may be taken as an example of a well arranged and economically operated plant, where floor space is not such an all-important matter as is the case of so many of the recently installed lighting stations, especially in large cities. The Hammond Light & Power company controls the exclusive privilege of electrically lighting the town, which has a population of about 10,000, and has built its station in a convenient location, near the tracks of a railroad. The work of the company at the present time is confined to lighting, and it has about 30 miles of circuits in operation. The plant is interesting from the fact that it includes apparatus for both the direct and alternating systems, the incandescent lighting being done entirely by the latter method. In the dynamo room, an illustration of which is presented upon this page, Fig. 1, six dynamos are installed, having a capacity of about 130 arc lamps and 2,200 incandescent lamps. The machines are all belt-driven from a 26-foot line-shaft, five inches in diameter, one end of which is connected to a 150 horse power Ball and Wood, simple, high pressure engine running at 220 revolutions a minute, the other to an Armington & Sims, simple, high pressure engine of 250 horse power capacity. The shaft is provided with the usual friction clutches and pulleys so that the engines may be run as twin engines, or independently, as the load requires. In the foreground of the picture is a National alternator having a capacity of 750 16 candle power incandescent lights, belt driven from an 88 inch pulley. The exciter for this machine is mounted upon the same shaft as the armature and forms one of the component parts of the dynamo. Besides this machine there are two Sperry arc lighters of 20 lights capacity each, driven tandem from a 58 inch pulley, a Thomson-Houston type M. D. 50 light arc dynamo running at a speed of 850 revolutions a minute, a Standard arc machine with a speed of 950 revolutions, driven from a 62 inch pulley and a La Roche alternator which has just been installed. The incandescent current is generated at 1,000 volts and transformed down on the line to 110. The addition of the La Roche machine completed the installation and utilized the last remaining space in the room. It was set up in the latter part of March and has a capacity of 1,300 16 candle power incandescent lamps. It runs at a speed of 1,075 revolutions a minute and weighs approximately 12,000 pounds. At the present time it is being somewhat overloaded, 700 amperes being required from it. It is driven from an 88 inch pulley and is of the latest type tooth armature construction with automatic regulation. On a test made at the station a short-circuit of 70 amperes was made across the terminals practically without heating of the armature or field coils. The test was made to demonstrate the fact that the armature will not be injured by short circuits due to high self-induction of the armature windings. The test was made with a normal exciting current. The machine and exciter are shown in Fig. 2. The station is equipped with two 72 inch by 18 foot boilers, having 54 four-inch flues, of 125 horse power capacity each, a Berryman heater and Worthington and Smith-Vaile pumps. The steam pipes are protected with asbestos, and everything about the plant is indicative of careful consideration in the installation. The plant is in charge of W. A. Trout and gives an all-night service.

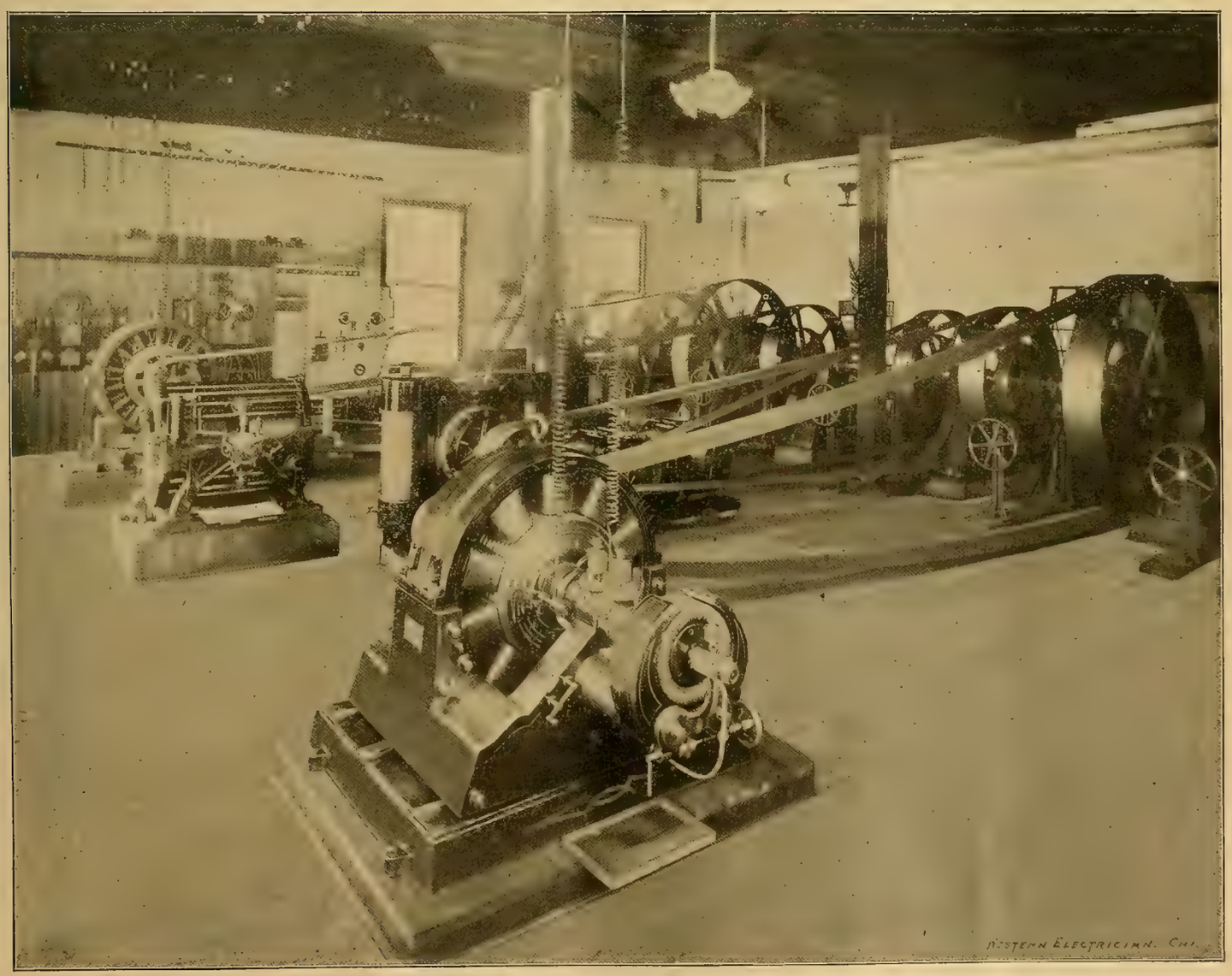


FIG. 1. WELL ARRANGED CENTRAL STATION PLANT.

American Street Railway Association.

The following is a list of the subjects and special committees appointed to report thereon at the thirteenth annual meeting of the American Street Railway association, to be held at Atlanta, Ga., October 17-19, 1894.

Can the T Rail be Satisfactorily Used in Paved Streets? Joel Hurt, president, Atlanta Consolidated Street Railway company, Atlanta, Ga.; S. Hendrie, manager, Wyandotte & Detroit River Railway company, Detroit, Mich.; H. J. Crowley, engineer, Atlanta Consolidated Street Railway company, Atlanta, Ga.

City and Suburban Electric Railways. Elwin C.

Foster, superintendent, Lynn & Boston railroad, Boston, Mass.

Mail, Express and Freight Service on Street Railway Cars. Richard McCulloch, electrical engineer, Citizens' Railway company, St. Louis, Mo.

The Best Method of Treating Accidents and Complaints. John B. Parsons, general manager West Chicago street railway, Chicago, Ill.

Street Car Wheels and Axles. D. S. Cook, electrical engineer, Trenton Passenger Railway company, Trenton, N. J.

Transfers and Commutation. Rodney Curtis, president Denver Tramway company, Denver, Colo.

The T Rail Construction of the Terre Haute Street

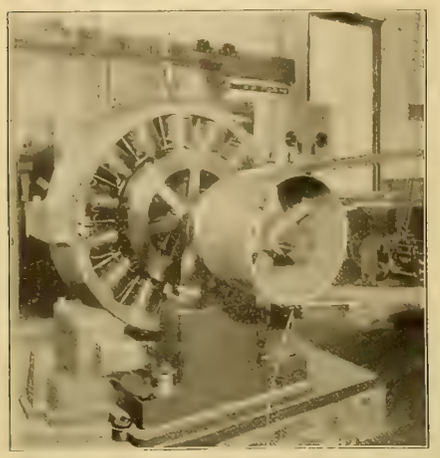


FIG. 2. WELL ARRANGED CENTRAL STATION PLANT.

Railway company, M. F. Burke, superintendent, Terre Haute Street Railway company. Terre Haute, Ind.

A Standard Form for Accounts for Street Railways. H. I. Bettis, consulting engineer, Atlanta Consolidated Street Railway company, Atlanta, Ga.

Pacific Coast Impressions.

Richard H. Pierce, late electrical engineer of the World's Fair, has returned to Chicago from a trip to the Pacific Coast and Rocky Mountain region, and in the course of a conversation with a representative of the WESTERN ELECTRICIAN he was asked what he had encountered during his visit which, from an electrical point of view, had impressed him most forcibly.

"Well," replied Mr. Pierce, "I was greatly interested in R. M. Jones' scheme for power transmission at Salt Lake City. Mr. Jones, who is an old-time civil and electrical engineer, and who has supervised the greater part of the electrical work which has been done in that region, proposes to utilize the power of the Big Cottonwood river by damming in a cañon near the city, where there is a sharp descent known as 'The Stairs,' the fall being 380 feet in about half a mile. I was struck with the natural advantages of the site, as the conformation of the cañon is such that there is a natural reservoir that can be utilized with comparatively little effort. The length of the electrical transmission line will be thirteen miles, and I have no doubt that Mr. Jones is correct in computing the energy which can be delivered in Salt Lake City at from 2,000 to 4,000 horse power. At any rate, there is little question that enough power can be obtained to operate the two electric railway lines of the city, perform all the arc and incandescent lighting and run the stationary motors, of which there are a large number in Salt Lake City. The plan seems perfectly feasible, and I hope that Mr. Jones will succeed in carrying it through after the existing period of financial depression."

"How about the California transmission plants?"

"The two that I inspected seemed to be successful. At Redlands they use the triphase current, as everybody knows who reads the electrical journals. The potential, I believe, is 2,000 volts, with transformers only at the end of the line. On the San Bernardino and Pomona line there is a transmission of 28 miles, and straight alternating current is used at 10,000 volts, with step-up transformers in the generating station and step-down transformers at the points of distribution. Part of the lighting in San Bernardino and all in Pomona is done by this electrically transmitted power. In both the plants I have mentioned water power is utilized. It seems to have been demonstrated that the question of long-distance transmission on the Pacific Coast is inseparably connected with the problem of irrigation. As you know, the land in Southern California is only made available for agriculture or fruit raising by bringing water to it by artificial means. Where the location is such that a natural watercourse can be made use of, first, as a means of generating electricity that can find an adjacent market, and, second, to fill the irrigating ditches, a plant can be operated at a profit. Otherwise, unless under especially favorable conditions, it is doubtful."

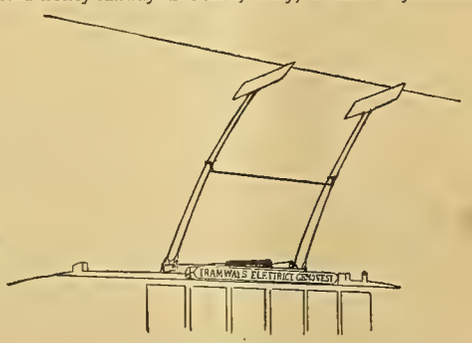
"What did you think of the Mid-winter Fair?"

"I thought the electrical showing, although not large when compared with the corresponding features at Jackson Park, was very good. There are no purely electrical exhibits, except one of mining machinery made by the General Electric company. All the other electrical machinery is made to do duty in lighting or furnishing power for the fair. The big tower, lighted by the Western Electric company, is a prominent feature, while attention is attracted by the big searchlight and electric fountain of the General Electric people. An unfortunate drawback is the fact that it so chilly in San Francisco at night that comparatively few people go out to the grounds in the evening, so that the fine lighting effects, which include a generous display of cornice lighting on the buildings, are not, perhaps, generally appreciated. Two of our old 'boys,' Sprout and Meredith, are in charge of the practical operation of the plant under the direction of Lieut. W. F. C. Hasson, and they have done good work."

In the further course of the chat Mr. Pierce complimented the excellent telephone service of San Francisco and described a phonograph attachment used in the exchange in that city. This consists of a simple switching device by which the operator can save her vocal chords when it is necessary to convey to a subscriber the information that "Linesbusynow. Pleasecallagain." The patient phonograph reiterates this until the subscriber becomes fully cognizant of the fact and hangs up his receiver, when it is automatically cut out of circuit.

Trolley Contact Arrangement on an Italian Railway.

The contact arrangement provided on the new overhead trolley railway in Genoa, Italy, is shown by the accompanying cut, which is reproduced from the London *Electrical Engineer*. The traveling contact consists of the upper side of a rectangular frame supported by two tubular uprights. It is formed of a special metallic compound, and is easily renewable when worn. It presses against the under side of the overhead conductor, strong spiral springs being used to keep the surfaces in contact. These spring are attached by one end to the bottom of the uprights, the other end being fastened to the roof frame of the car. Two contact bars and frames are provided for each car, mounted on the roof, as shown in the illustration.



TROLLEY CONTACT ARRANGEMENT ON AN ITALIAN RAILWAY.

The advantages claimed for this method of obtaining current from the line wire are the following. In the first place, a greater degree of reliability in maintaining contact is secured as compared with the rolling contact, and obviously there is not the same danger of jumping away when the car oscillates endwise. Moreover, the contact bar is made of a length almost equal to the width of a car, so that ample swing is allowed for. In the second place, much of the overhead straining or pull-off wires are rendered unnecessary at curves since the conductor or line wire need not follow the rounded curve of the rails, but can form a chord across, since the length of contact bar is enough to preserve contact, although at different points as the car moves round. This advantage, as the English journal observes, becomes of no small importance when it is remembered that in many cases the only serious objection to the use of electric tramways on the overhead wire system lies in the ugly and unæsthetic appearance of the numerous wires—conductor and supporting—at the curves. Any method which avoids this objectionable feature deserves strong recommendation.

Storage Battery Traction in Chicago.

The storage battery car which has been running for the last six months upon West Twenty-second street, Chicago, has been leased by the Globe Storage Battery company to the Chicago Lawn Street Railway company, which operates a road from Sixty-third street to Chicago Lawn. The franchise which the company holds permits of the utilization of any system excepting the trolley, and it is intended to experiment with the storage battery system with the idea of adopting it if it should meet the requirements demanded of it. The car has made a very satisfactory showing during the time of its operation upon the West Side road, and it is expected that with the extension of the road a number of these cars will be placed upon it. It is claimed by the Globe company that there has not been a renewal upon any of the batteries since the car was started, and that they show no indication of wear or strain.

Novel Construction for an Elevated Electric Railroad.

The lately incorporated Northwestern Elevated Railroad company has a franchise to construct an elevated railway in Chicago to connect the central business portion of the city with the thickly settled residence district of the North Side, and is preparing to build the line. Much difficulty has been encountered, however, in securing the right-of-way in the down-town business district, as the merchants and other property owners are loth to consent to the street obstruction caused by the overhead structure, even though the improvement is conceded to be a desirable one. To obviate this objection the engineers of the company propose the bold expedient for carrying the elevated railroad, through the buildings instead of over the streets or alleys. Of course this tunneling could not be considered for a moment without the use of electrically transmitted power on the line, as the use of electric motors does away with smoke and cinders entirely and greatly lessens the noise. The Northwestern company will undoubtedly use electricity, and its engineers insist that the plan of going through buildings is a perfectly feasible one.

Sketches showing the proposed construction in a five-story building are given in Figs. 1 and 2, the former showing a front elevation and the latter a longitudinal section. The railroad structure is to rest on its own foundations, entirely independent of the building, leaving side spaces on either side of the tracks for small structures or booths similar to an arcade. The remainder of the building is to remain intact. In advocating this plan the Northwestern company points to the example furnished by the terminal station of the Metropolitan "L" road at the foot of New Church street in New York. A building facing on Broadway is used for the entrance to this station, and it is asserted that its value for renting purposes has been enhanced 150 per cent. by the proximity

FIG. 1. NOVEL CONSTRUCTION FOR AN ELEVATED ELECTRIC RAILROAD.

of the elevated railroad station. The Chicago company, having decided to use electricity, thinks that it will be possible, in many cases, to arrange for an easement through down-down buildings in consideration of the establishment of stations in the buildings, thus increasing their value for renting purposes. This, however, is an assumption that remains to be proved, conceding that there

are no insuperable objections from an engineering point of view.

The Northwestern company has in prospect an extensive project for an elevated electric railway, and its plans are therefore of much interest to the electrical fraternity. It is the company's purpose to erect a two-track structure in the business district, south of the Chicago river, and a four-track line north of the river. In the central portion of the city trains are to stop at every street crossing, but on the other side of the river the two inner tracks are to be used for express trains running to the city limits, while the outer tracks will be utilized for local business. This proposal, if carried out, would certainly give the North Side very excellent facilities for rapid transit.

While plans for the elevated structure have not been perfected in detail, it is proposed to follow the same general plan as that of the South Side "L" road in Chicago. The proprietors, however, claim a number of advantages over that construction. They say their line will be lighter and stronger and at the same time less unsightly. It is also claimed that it can be placed in position with much greater rapidity. The route as laid out by the company provides for a bridge across the river between La Salle street and Fifth avenue. Vesselmen, it is said, are complaining bitterly against a proposition to erect any more bridges at that particular part of the river. Bridges are planted there at every street. The river is always congested at that point and navigation at the best is difficult. The company, however, is said to have made application to the United States government for permission to construct the bridge at that point. The war department will refer the matter back to the government engineer at Chicago, and the matter will be given a careful investigation. The rivermen, it is said, propose to make their hardest fight in the engineer's office. In case they win the Northwestern company will have to change its route or cross the river at one of the existing bridges, which, under the ordinance, it will be obliged to remodel at its own expense.

Electricity Applied to St. Etienne Industries.

Consul Charles W. Whiley, Jr., writing from St. Etienne, France, pays tribute to the industrious habits of the laboring class there and considers the prospective use of electricity in the city for power purpose. Of the 18,000 looms in St. Etienne, the greater number are owned by the individual weavers and worked by hand in their own homes. While it is probable that the recent inventions for the transmission of power by electricity will shortly effect an alteration in the methods, it is not thought that it will change, to any great extent at least, the location of the work. Until very recently the ribbon-weaver, laboring in his own home, could see no room for improvement in the mechanical execution of his work. Of late, however, his eyes have been opened to the advantages to be gained by the use of electricity, and to-day it is not a rare occurrence to find a humble weaver who can talk of dynamos and motors with intelligence. Already over sixty looms are being worked by electricity, the force being furnished by the Edison Electric company. This company has for several years supplied the light to a large number of shops, hotels and other establishments in the city, but more recently it has undertaken to furnish electric force to the numerous looms in the district. To this end it has established an elaborate electric plant on the River Loire, at the foot of the picturesque village, St. Victor-sur-Loire, situated about eight miles from St. Etienne. A waterfall of 900 horse power sets in motion three turbines, which transmit the electric force through four cables seven millimeters in thickness. A great increase in the number of looms is anticipated during the next six months.

Just now the ribbon business is extremely dull, but it is confidently expected that with the revival of trade every loom owner will wish to take advantage of the electrical energy. The actual expense under this system is 350 francs per loom, including motor, pulleys, belts, etc., all of which become the property of the weaver. An additional sum of 10 francs per month is charged for each loom. If the loom remains idle for more than a fortnight in any one month, a proportionate reduction is made by the company. A weaver who is the owner of two looms driven by electricity recently stated that by this agency he can turn out 25 per cent. more work than formerly. The large ribbon factories of St. Etienne are, as a rule, worked by steam power. There is one factory, however—that of Messrs. Forest & Co.—which is worked entirely by electricity. In this factory, which is of recent construction, there are one hundred looms for the manufacture of the various styles of ribbons—silk, velvet, fancy ribbons, etc.—and a number of others for the making of plush. All these looms are worked by electricity furnished by two powerful dynamos situated on the ground floor. Each loom has its own accumulator, regulating the velocity according to the article manufactured, and when it is stopped the current is turned off, so that no waste of electric power is allowed. This firm owns another factory in the country about 50 miles from St. Etienne, which is also run on the electric system. The electric power is conveyed to the factory, a distance of eight miles, by means of overhead cables. The generators are connected to turbines. Messrs. Forest & Co. claim that the advantages of the improvement are manifest; that the movement produced by electricity is more uniform and gentle than that obtained by steam, and that, while the cost of construction is not greater, there is more economy in the working and maintenance of electric machinery than under any other system. In the neighborhood of Grenoble, in the Department of Isère, the application of electricity has had a marked effect upon its various industries. Electric bleaching of paper pulp is extensively resorted to in its paper mills. Near Grenoble, at a place called Lancey, there is a paper factory worked entirely by electricity. The current, feeding a motor of 200 horse power, is transmitted from a station located five miles up the river. The largest aluminium manufactory in France, producing 200 kilogrammes a day, is also located near Grenoble. A copper refining manufactory, that of M. Grammont, has been in operation for some years in the Department of the Isère; these works turn out 1,500 kilogrammes of wire daily.

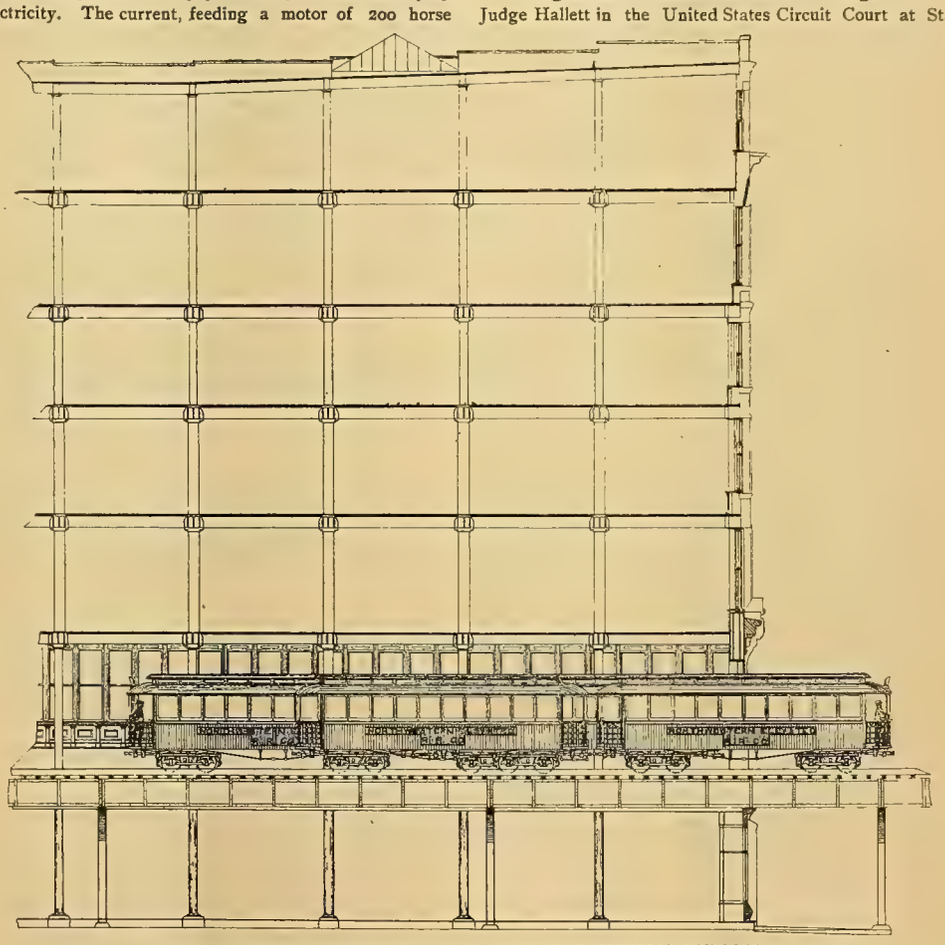


FIG. 2. NOVEL CONSTRUCTION FOR AN ELEVATED ELECTRIC RAILROAD.

American Institute of Electrical Engineers.

The Philadelphia local committee is making elaborate arrangements for the entertainment of members of the Institute who attend the coming annual and general meetings in that city. The social features are being especially arranged with regard to the attendance of ladies. This being the tenth anniversary of the Institute, the rule of strict attention to business will necessarily be relaxed somewhat in order that members and guests may avail themselves of the proverbial hospitality of the city of Brotherly Love. In addition to the list of papers published last week, Dr. Louis Bell will present one upon "Some Facts about Polyphase Motors."

A brief outline of the preparations in progress under the direction of Chairman Willyoung of the local committee embraces the following:

On Tuesday, May 15th, address of welcome by Mayor Stuart, to be followed by the annual business meeting and reading of papers. Mr. Wurts' paper on "Lightning Arresters" will be accompanied by experimental demonstrations at the station of the Philadelphia Traction company. In the evening the annual dinner of the Institute and a theater party for the ladies.

Wednesday afternoon, a tally-ho excursion will be provided for the ladies, and the Engineers' club will hold a reception in the evening.

Thursday afternoon will be occupied by a visit to Cramp's ship-yard, followed by a steamer trip down the river to Gloucester, where a shad dinner will be served.

Fuller details of the arrangements will be given in the official programme. Visiting members will be welcome to the office facilities of Houston & Kennelly, Rooms 1105–1106 Betz building, near the Pennsylvania Railroad station, where letters may be addressed in advance of their arrival.

The secretary of the Institute would deem it a favor if those who propose attending the meeting would write him to that effect at 12 West Thirty-first street, New York city.

Adams-Lindell Railway Suit.

The arguments of counsel in the suit brought before Judge Hallett in the United States Circuit Court at St. Louis by the Adams Electric Railway company against the Lindell Railroad company were concluded last week, and the case now rests with the judge. The plaintiff seeks to recover for infringement of the patent granted to it in 1884 for the application of electric motors to the axles of railway cars. The defendant company uses the Sprague-Edison system, and the defense therefore fell to the General Electric company. A large amount of written testimony, taken before special commissioners, was introduced in the case, and the time in court was almost entirely taken up by the arguments. The principal defense was that steam engines were connected with the axles of railway cars long before the patent was taken out, and that a patent could not rightfully issue for the application of electric motors for that purpose, as the principle was the same, one motor being simply substituted for another.

New Electric Road in Chicago.

Work of construction of the Englewood and Chicago electric road has been begun. Operations will be pushed forward rapidly and some of the road, it is expected, will be open for business in a few weeks and all the ten miles contracted for will be in running order in a short space of time. When completed the road will connect the towns of Park Manor, Brookline, Oakwoods, Eggleston, Auburn Park, South Englewood, Tracey and Washington Heights. It will run out Vernon avenue to Sixty-seventh street,

along Sixty-seventh street from Cottage Grove avenue to State street, on Vincennes avenue from Sixty-seventh street to South Chicago avenue, thence on South Chicago avenue to Seventy-first street, thence west on Seventy-first street to State, south on State from Vincennes road to Seventy-ninth street, west on Seventy-ninth street to Vincennes road, south on Vincennes road to One Hundred and Seventh street. It will also run on Eighty-sixth street from Sangamon to Loomis and south on Loomis to the Chicago and Rock Island railroad tracks. For the present the company will lease the power for its trolleys, though eventually it is intended to erect a power house by the tracks of the Indiana Railway company, so as to be near the coal supply. The officers of the Englewood & Chicago Electric Railroad company are: President, W. H. Comstock; vice-president, A. J. Whipple; secretary, F. E. Elder. The capital stock is $1,000,000. William V. Jacobs, who built the Calumet system, was the promoter of the new enterprise. The franchise was granted last summer.

Invention and Development of the Telephone.[1]

By Herbert Laws Webb.

The Blake transmitter does not give a sufficient volume of sound to allow of its general use for talking over long circuits, and with the introduction of long-distance teleph-

FIG. 1. INVENTION AND DEVELOPMENT OF THE TELEPHONE.—LONG DISTANCE TRANSMITTER.

ony in this country there was produced a transmitter adapted to this special class of work. This transmitter, which has become well known as the "long distance," was the result of an extended series of experiments conducted in the American Bell laboratory, and it is a very excellent instrument, although it is is now being supplanted by a later form called the "solid back."

The "long-distance" transmitter, Fig. 1, is of the Hunning type, depending for its variable resistance on the compression and separation of carbon granules, but the mechanical and electrical details are far more carefully worked out than in any other form of the Hunning transmitter. The construction is as follows: An iron box attached to the backboard contains the induction coil and supports a nickel-plated arm, which carries the transmitter case. The transmitter case is of metal and has a small circular chamber, or shallow tube, the lower side of which is closed by a thin platinum diaphragm and the upper by a circular metal plate. The diaphragm is fastened to a brass ring, and really forms with this ring a shallow box, which is carefully insulated from the metallic case, as the dia-

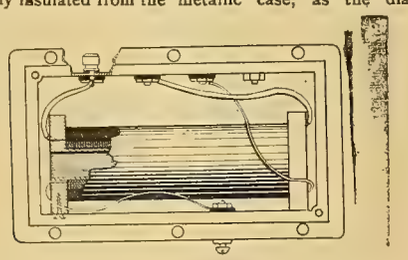


FIG. 3. INVENTION AND DEVELOPMENT OF THE TELEPHONE.—INDUCTION COIL OF THE LONG DISTANCE TRANSMITTER.

phragm rests on a ring of hard rubber, and the brass ring is surrounded by a boxwood collar. This collar is slightly higher than the brass ring, and its upper edge supports a peculiarly shaped electrode, which makes metallic contact with the cover of the transmitter case. This electrode has the form of a small pulley with the upper flange somewhat wider than the other. When the pulley rests on the boxwood collar, its lower surface is one-sixteenth of an inch above the platinum diaphragm. The pulley has a conical hole through the center, and its grooved rim is pierced with holes that communicate with the central one, so that it forms a sort of a grid or grating, Fig. 2. Its purpose is to prevent the carbon granules from packing and to afford plenty of conducting surface through the comparatively large amount of metal it exposes at the lower face, grooved rim and numerous perforations. The pulley shaped electrode is gold-plated; its lower surface is slightly concave and highly burnished. When the electrode is in position a quantity of finely granulated carbon is poured in, filling up the space between the diaphragm and the electrode and partly filling the space between the grooved rim and the brass ring and the holes in the electrode.

The circuit is made from the diaphragm (to the edge of which is attached a binding post insulated from the transmitter case) through the carbon granules to the electrode and thence by the metal case and arm. The primary wire of the induction coil is connected to two insulated binding posts on the iron box, Fig. 3. One of these is connected by an insulated cord to the insulated binding post attached to the diaphragm, and the other to one pole of the battery. The automatic switch that throws on the battery is connected to the metal arm of the transmitter, thus completing the circuit through the cap of the transmitter case, which is in metallic connection with the pulley shaped electrode. The voice is directed to the underneath side of the diaphraghm by a hard rubber mouth-piece screwed into a socket in the metal transmitter case, Fig. 4 The vibrations of the diaphragm agitate the carbon

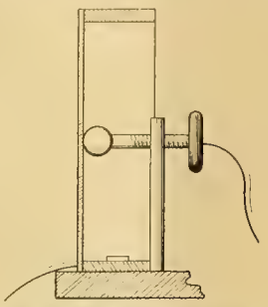


FIG. 5. INVENTION AND DEVELOPMENT OF THE TELEPHONE.—BERLINER'S FIRST TRANSMITTER.

granules, which, being in a finely divided state, offer many points of contact and give a wide range of resistance.

This transmitter has many advantages. It is compact, and sightly, and when once properly set up it needs on adjustment. It can be used with a large battery power and gives a very loud transmission. The small size of the transmitter case makes it adaptable to numerous convenient and ornamental forms of desk and table instruments, as the induction coil can be put in a separate place. Its chief defects are the extreme delicacy of the platinum diaphragm, which is of very fine foil and is liable to slight indentations and other defects that depreciate the transmission, and the tendency of the granulated carbon to "pack." The packing of the carbon granules, giving the carbon a condition approaching that of a solid cake of the material, affects the transmission very seriously. The vibration of the transmitter in ordinary use has a tendency to pack the carbon, and this is aided by the heating of the

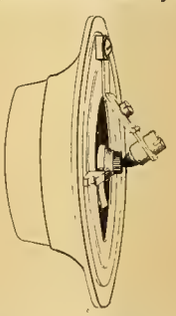


FIG. 6. INVENTION AND DEVELOPMENT OF THE TELEPHONE.—BERLINER'S CARBON TRANSMITTER.

transmitter by the battery current; the remedy, apart from taking the transmitter to pieces and supplying fresh carbon granules, is to tap the transmitter lightly at the sides. To protect the diaphragm, which is the only delicate part of the instrument, from outside interference, a couple of stiff wires are placed across the narrow end of the mouthpiece.

THE BERLINER TRANSMITTER.

Berliner is an interesting name in telephony. Berliner discovered in 1877, independently of Hughes—the results of whose work were published at a later date—the principle (or rather its application to telephone transmitters) of the variation of resistance at a loose contact subject to variation of pressure. Berliner lodged a caveat in the Patent Office, broadly claiming this invention in April, 1877, and in June he applied for a patent. Edison had been working in the same line and applied for a patent in July of the same year. Berliner and Edison were declared in interference by the Patent Office. This interference was not finally decided in favor of Berliner until

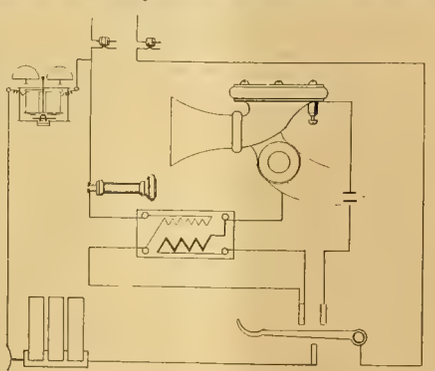


FIG. 4. INVENTION AND DEVELOPMENT OF THE TELEPHONE.—DIAGRAM OF CONNECTIONS OF LONG DISTANCE TRANSMITTER.

1886; but meanwhile, in 1880, Drawbaugh appeared on the scene with an application for a patent on a microphonic transmitter, and, according to the rules of the Patent Office, no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by causing sound waves to vary the pressure between electrodes in constant contact, so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit." The Edison patent issued in May, 1892, covers the use of carbon in telephone transmitters (Berliner, up to the filing of his application, had experimented only with metal contacts), and the broad claim is as follows: "In a telegraphic apparatus operated by sound the combination with the diaphragm of one or more contact points of plumbago or similarly inferior conductor in the electric circuit, whereby the rise and fall of electric tension is proportionate to the pressure exerted upon the said point or points by the diaphragm." It will be seen that a combination of the Berliner and Edison patents practically embraces the fundamental principles of almost all battery telephone transmitters.

Fig. 5 represents the original form of experimental

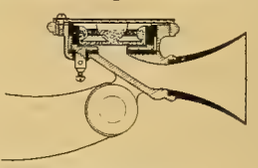


FIG. 2. INVENTION AND DEVELOPMENT OF THE TELEPHONE.—SECTION OF LONG DISTANCE TRANSMITTER.

transmitter devised by Berliner, having a metal plate forming the diaphragm with a metal ball resting against it. One side of the circuit was connected to the diaphragm and the other to the ball. The resistance of the contact between plate and ball was varied by the vibration of the diaphragm, thus setting up the electric undulations. It will be seen that this arrangement is suspiciously like a "make and break" transmitter, as no device is shown for allowing the electrode to follow the diaphragm in its vibrations.

Fig. 6 shows Berliner's first form of carbon transmitter. In this instrument, which was brought out in the early days of carbon transmitters, the important improvement of giving one of the electrodes a yielding support was adopted. One of the carbon electrodes is attached to the diaphragm and the other to a socket carried on a hinged piece on the end of a bent spring secured to the transmitter case. This manner of disposing of the carbon con-

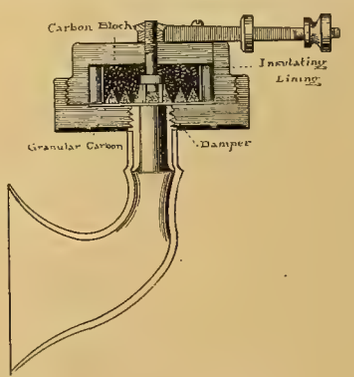


FIG. 7. INVENTION AND DEVELOPMENT OF THE TELEPHONE.—BERLINER'S "UNIVERSAL" TRANSMITTER.

tacts was a forerunner of the Blake invention, which is an improvement on it.

Berliner's "Universal" transmitter, Fig. 7, is entirely different from his early instruments. It is an excellent transmitter and well adapted to long-distance work. It has not been adopted in this country at all, but is used in South America and in some parts of Europe. In general principles of construction, although not in detail, it resembles both the "long-distance" and "solid back" transmitters. The diaphragm is a carbon disk forming one electrode. The second electrode is a circular block of carbon held so that its lower surface is a short distance above the carbon disk. The lower surface of the carbon block is corrugated, a number of deep circular grooves being cut in it, and the space between the disk and block being occupied by carbon granules; these grooves or corrugations fulfill the double purpose of affording plenty of contact surface and of dividing up the granulated carbon so as to minimize the effect of "packing."

The transmitter chamber is formed of a circular wooden box with a short tube screwed through the bottom for the mouthpiece. The cover, also of wood, with a brass ring round its lower edge, screws into the box and clamps down the carbon diaphragm, the connection from one side of the primary circuit to the diaphragm being made through the brass ring. The cover has an insulating lining of thick felt, which closely surrounds the upper carbon electrode, and whose lower edge rests on the diaphragm. Thus a

1. From advance proofs of "The Telephone Hand-book," published by the Electrician Publishing company, Chicago (now in press). Price, $1.

NOTE.—Transmitters of a number of other forms, both American and European, are described in "The Telephone Hand-book."

small chamber enclosed by the diaphragm, upper electrode and insulating felt lining is provided for the granulated carbon. The upper electrode is supported by a slightly tapered brass pin fitted tightly into a hole bored through the center of the block. The lower end of this piece carries a small piece of soft rubber tubing, which bears lightly on the diaphragm and serves as a damper. The pin is clamped to the top of the cover by a screw nut. The mouthpiece used with this instrument is usually made of soft rubber.

From the foregoing description it will be apparent how close is the resemblance, as far as the general arrangement goes, between this transmitter and the two instruments used for long-distance work in this country. The differences are mainly in the details of construction, which have been more carefully worked out in the transmitters used by the Bell companies. The "solid back," utilizing the same principle of two carbon electrodes with a layer of granules between, is a much more efficient transmitter than the Berliner. Fig. 7 is a section of the Berliner "Universal" transmitter.

New Ironclad Dynamos and Motors of German Manufacture.

Interesting as showing a recent development in German electrical practice in the manufacture of ironclad direct current generators and motors designed with particular reference to efficient ventilation are the machines illustrated by the accompanying cuts, which are reproduced from the *Elektrotechnische Zeitschrift*. These dynamos have just been brought out by Poeschmann & Co. of Dresden, and, as the pictures clearly show, they possess several novel features. Fig. 1 gives a sectional view. The form is

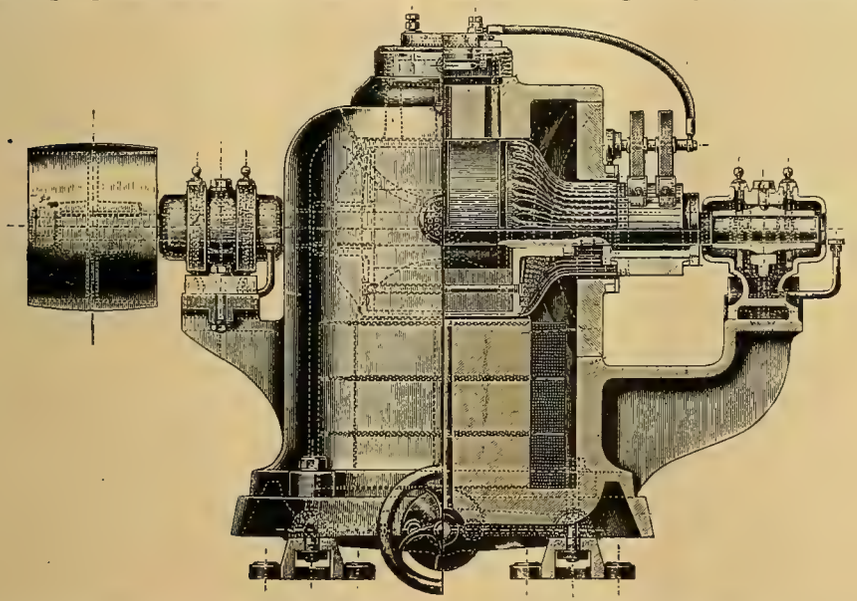


FIG 1. NEW IRONCLAD DYNAMOS AND MOTORS OF GERMAN MANUFACTURE.

almost cylindrical, one side—that from which the commutator projects—being somewhat flattened. On this side the casing may be removed to allow the insertion of the armature.

The armature in revolving serves as a blower to a sufficient extent to cause excellent ventilation about it, wire-covered gauze holes in the pole pieces permitting the ingress and egress of the air. The shaft rests on ball bearings, and the mechanical details are carried out to the utmost nicety. A 200 light dynamo is said to have shown an efficiency of 91.5 per cent. at half load and 93 per cent. at full load.

Fig. 2 shows a motor with starting rheostat mounted on top of the pole pieces, and Fig. 3 represents the relative size of a 400 light dynamo and a 1-5 horse power motor of the same type.

Milwaukee's Street Railway Troubles Settled.

Just as all the street car employes of Milwaukee seemed to be about to strike, a settlement was effected by the company's yielding absolutely to the demands of the men. One year ago the company signed a scale providing for 19 cents an hour for motormen and conductors. The understanding at that time, it is said, was that the pay was to be increased to 20 cents an hour at the end of this month. A few weeks ago the men became suspicious that instead of an increase being granted a reduction would be made, and they prepared to resist any step of the kind. National President Mahone came to the city, and he soon had the men well organized. Then the men, through the committee, began to confer with the officials of the company, who at first would not declare that any reduction was intended. A short time ago, however, the company changed its tactics, and the men were informed that on May 1st their wages would be cut to 17½ cents an hour. The men were firm from the start, and they informed the company that they would not accept the reduction. President Mahone was sent for, and in the meantime the men so perfected their organization that it included almost every conductor and motor man in the city, as well as many men who had been secured by the company to take the places of strikers. There were more conferences between the men and the company. William Nelson Cromwell, the Northern Pacific railroad lawyer, who is president of the Milwaukee Street Railway company, arrived from New York to confer with the other officers, and Vice-president Henry C. Payne of this city postponed a trip to Europe for the benefit of his health in order to look after the company's interests. The company lost no time in enrolling men to take the places of the old employes in case the latter struck. Emissaries of the company, it is claimed, were getting men at St. Paul, Minneapolis, Chicago, St. Louis, and other cities. The men saw danger from this source, and they informed the company that unless the enrolling of new men was stopped, and men who had been put on the cars with them were taken off, they would strike on the shortest kind of notice. The company temporarily suspended the enrolling of new men, at least in the city, and the old employes were told that a final decision on the subject of wages would be rendered after a meeting of the board of directors in New York. Before the final conference the men made another clever play. They not only declared that they would accept no reduction, but they threatened to strike at once, instead of waiting for May 1st, unless the company promised to continue the old wages. They could not afford to wait until the 1st of May, they said, because the company would have too much time in which to prepare for a strike. Speaking of the reasons for making the reductions, Mr. Payne is quoted as saying that for the first seventeen days of the present month the earnings of the company had decreased $5,334.65, an average falling off each day of $313.80. Since its organization, he said, the company had not been able to pay interest upon its bonds, and up to last December the persons interested in the road advanced the money with which to pay the interest. Owing to financial difficulties the owners of the road did not see their way clear to paying the interest which became due last December and a default was made. The interest was not paid at that time and it has not been paid since. It was far enough toward June, Mr. Payne stated, to assert with certainty that the interest due in that month would not be paid, not having been earned. Thus they could see, Mr. Payne told the men, that only the sufferance of creditors prevented the company from being forced into bankruptcy. So far as the stock was concerned, he said that the company had no hope of earning a dividend for some time. He himself had been drawing no salary since the first of January, having waived it. Nor was any New York official receiving a salary. The salaries of the superintendents, he said, were not any higher than those paid to superintendents in other cities.

Mr. Payne offered to compromise with the men. He said that from May 1st the company would pay 18 cents an hour, or it would submit to arbitration the question whether the wages should be 17½ cents an hour or 19 cents an hour. When the representatives of the men said that neither of these propositions could be accepted, the company, Mr. Payne stated, would either arbitrate as above proposed, or it would pay 19 cents an hour from May 1st to November 1st, and 18 cents an hour from November 1st to May 1st. Under the latter proposition the wages of the men would average 18½ cents an hour the year around, only half a cent an hour less than they had been getting, but the men declared that they would not accept the offer. Mr. Payne finally surrendered at discretion, and the old scale was signed again. The men are in a very happy frame of mind, and feel that they have

FIG. 3. NEW IRONCLAD DYNAMOS AND MOTORS OF GERMAN MANUFACTURE.

won one of the most notable victories in the labor annals of Milwaukee, and that without resorting to the least violence and without striking. What the company will do next is an interesting question. From its statements to the men, it is in a poor condition financially, and it apparently must do something to cut down expenses. It is feared the service may suffer.

Chicago-St. Louis Electric Railway Project.

The project for connecting Chicago and St. Louis by an air-line electric railway on which trains are to be operated at the rate of 100 miles an hour, although held in abeyance for some time, has not been abandoned. Chief Engineer Hughes announces that the contract for grading the track-way of the Chicago division, extending from this city to Alpine, Ill., a distance of 25 miles, has been let and work has been just begun. It is stated that the company is considering three propositions for terminal facilities in Chicago—two on elevated tracks and one on the surface—but that the definite route is still undetermined. The company proposes to use overhead wires, with center-pole construction, and the tracks will go either under or over all railway, country road or street crossings. The plan contemplates the erection of power stations about thirty miles apart, using the cheap soft coal with which the interior of the state of Illinois abounds. Multiphase current will be generated, transformed down in sub-stations located along the line at intervals of about five miles. This plan involves the use of multiphase motors on the car trucks, and at least two electrical companies have agreed to furnish guaranteed motors of this type. It is possible, however, to use rotary transformers in the sub-stations, and thus supply direct current to the car motors. Seventy-five pound T rails, laid at standard gauge, will be used. It is claimed

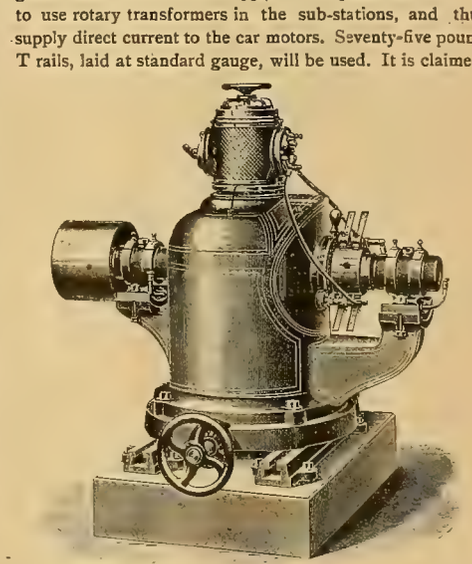


FIG. 2. NEW IRONCLAD DYNAMOS AND MOTORS OF GERMAN MANUFACTURE.

that the finances of the company are now in fairly good shape and that the road will be built.

Some time ago a commission was appointed in Boston to decide upon the best means of rapid transit. The commission reported in favor of the subway scheme. The estimated cost is from $5,000,000 to $15,000,000. The utilization of electricity as a motive power is being given due consideration.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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MAYOR HOPKINS of Chicago announces in his annual message, recently submitted to the city council, that he will not approve any ordinance granting a franchise to a corporation or individual that does not contain the essential features consistent with the policy which he adopted upon assuming office. He believes that the policy pursued in New York and that which obtains in Cleveland might be combined in Chicago. He says: "The New York method of compelling a sale of the franchise to the highest bidder has had most excellent results, and the system adopted in Cleveland, by which franchises are granted to companies making the lowest bid by way of cost to the citizen of the article supplied, be it transportation or gas, etc., is equally commendable. In my opinion the two methods should be combined, so as to yield a fair and certain revenue to the city, and at the same time give to the citizens increased and cheapened facilities." The mayor insists that when it is once understood that this policy has been adopted there will be no further trouble and that seekers after franchises will comply with these requirements. Promoters of electrical projects in Chicago will be interested in this decision, especially as the mayor seems to have forced the city council to adopt his views in a measure at least. The electric railway enterprises were the first to which the new rule has been applied. The North and West Side companies, it is said, have come to the conclusion that they may as well accept these conditions.

NOT from any pronounced friendliness to the conduit system, but to make a point against overhead trolley wires, the *Chicago Herald* of April 29th devotes a column and a half of its space to an attempt to describe the electric railway at Budapest, which is operated from underground conductors. This road has been familiar to electricians for years, and the *Herald* article is of no importance except as an example of the ignorance which so many daily papers exhibit in treating of electrical subjects and which renders comment from such journals on a subject like the present agitation for electric railways in Chicago, for instance, almost entirely valueless. An example of this trait is shown by the following bit of luminous description:

As to the electric motor car itself, that differs but very little in appearance and construction from our best cable or other street cars. Under it, between the two sides, reposes the secondary dynamo, inclosed in a box. The dynamo transfers the motion of its anchor, by means of an attachment, onto one of the hubs. Under the front platform of the car are arranged the parts of mechanism which enable the conductor to put on greater speed or slacken or stop. The whole apparatus, as fitted upon and in these cars, is simple and does not deprive the car of any of its seating capacity.

After this meaningless jargon about the "anchor" of the "secondary dynamo," the writer makes mention of the method of distribution, and adds, with a brave assumption of hidden knowledge: "As to the technical details involved in the operation it would serve no useful purpose to give them here, since but electrical engineers and other experts would be able to grasp their meaning." We are glad to be accorded this relief, at all events.

IT is due to the steam railroad men of the country to recognize the fact that, as a class, they have manifested admirable fairness and lack of prejudice in examining the claims of the electric motor to be considered as a serious factor in the long-distance railroad traffic of the country. When the time comes when steam locomotive shall be superseded by electric motors—a chance that many observers believe to be gradually impending—each of the great railroad companies, as it falls into line, will be put to great expense for generating machinery, line construction and motor outfits. Notwithstanding this fact, several companies have instituted careful and thorough investigations of the problem, and although it may be urged that this course was actuated by ordinary business prudence and with an idea of eventually securing a material reduction of operating expenses, the fact remains that the whole subject has been discussed by the steam railway men with a candor and moderation worthy of all praise. Indeed, there are not wanting electric railway advocates who would command a greater degree of public confidence were they to modify their enthusiastic claims with a like degree of careful reflection and judicial fairness.

Mr. Barnes' paper before the Western Railway club, a generous abstract of which is presented in this issue, may be cited as an excellent example of this spirit. The relative merits and defects of each system, as at present developed, are weighed with the temper of a judge, not colored by the zeal of the advocate. This is precisely as it should be, and the author is entitled to congratulation for his calm and interesting treatment of the subject. Mr. Barnes' desire to be perfectly fair is shown by his reference to the tug-of-war between steam and electric locomotives at the World's Fair last summer. He coincides in the opinion expressed in the WESTERN ELECTRICIAN at the time that the test did not fairly display the relative merits of the two machines and points out how the conditions could have been made more equal. Mr. Barnes has prepared an interesting paper, and we heartily commend its perusal to all interested in this important subject.

THE work of introducing electrical mining machinery has progressed slowly, and this has been due partly to the conservatism of the mining operators, and also, to some extent, it must be confessed, to defects in the electrical appliances especially designed for use in mines—particularly coal mines. The problem of applying electrically transmitted power to meet the peculiar conditions found in coal mines is one that has engaged the attention of some of the brightest minds that have grappled with the practical work connected with the utilization of electricity. Faults in successive machines have been discovered and overcome, with praiseworthy perseverance, until now it can be asserted with confidence that electrical machinery is destined to play a very important part in the mining operations of the future. Indeed, this fact is attested by those who are most familiar with the business of mining coal, as may be judged by the following extract from an editorial in a recent issue of a leading journal devoted to the coal trade: "It is being forced upon the minds of mine owners that successful coal mining in the future will have to depend upon electrical machinery. Many devices now used in and about mines will undoubtedly continue still to be used for a long while to come, with the difference that electrical shall have succeeded manual power. This is good for the miner, as it will relieve him of the heaviest toil, and will find him employment in the increased mining that will result from this economy. But the benefits that will accrue to the operator who indulges in the use of the latest and most improved machinery for his mines will be far greater. It will not only place him in a favorable position for trade, but will break down that barrier of expense which has unquestionably hitherto operated to a considerable degree in restricting his efforts to seek a foreign market. Owing to natural conditions the expense of mining in this country should be far cheaper in every respect than they are in Britain, if advantages are only taken of the means which are at hand. By the aid of machines, coal can be placed on the car for thirty cents cheaper than when mined by hand labor, and, what is of equal importance, in a far better condition. Not to seek, therefore, to utilize these facilities in the way of extending trade abroad, is to camly ignore the chances which present themselves."

It will be seen that the outlook for a growing demand for electrical mining machinery is encouraging. Manufacturers and designers should not relax their efforts to adequately meet the needs of the mining operators. The field is promising and should be more fully occupied than it is.

To the Chicago city council must be given credit for establishing order out of confusion in settling, so far as it can, the trolley agitation by passing a reasonable measure, which, it is said, will be accepted by the North and West Chicago Street Railway companies. Last Monday night Mayor Hopkins returned to the council without his approval the franchises originally passed by that body with several suggestions which were subsequently embodied as amendments, and the new measure, including the mayor's substitute, was passed in such form as to be satisfactory to the mayor and the companies. The ordinance as passed provides for the payment by the companies of the sum of $10,000 at the expiration of the first year, $15,000 at the expiration of the second year, $20,000 at the end of the third year and $25,000 at the end of the fourth year and each succeeding year, the money thus obtained to be used by the city in extending its lighting service. This amendment was adopted in lieu of the idea of compelling the street railway companies to light the streets upon which they operate trolley lines within a radius of one mile from the city hall. Another section provides for indemnity to the city from all damages which may result from the building and occupation of its streets by the overhead trolley system. A metallic return circuit conductor, independent of the rails upon all the lines authorized, is demanded, and provision is made for suitable guard wires and ornamental iron poles instead of wooden supports.

The mayor's message showed that he was still greatly opposed to the trolley. He practically washed his hands of the whole matter. He said that he believed that the aldermen would overrule his objections to trolley roads anyway and that it was his purpose to get as much for the city in the ordinance as possible. He called the overhead trolley "almost antiquated and in many respects objectionable," gave expression to the well-worn phrase, "the trolley system, with its unsightly poles and wires," and testified his belief in the ultimate success of the conduit system. However, he is reported to have expressed the intention of approving the measure as passed. It would seem that Chicago, to a certain extent, is in a fair way to obtain some of the advantages of rapid transit upon its cross-town lines on the North and West sides. With the mayor's signature the situation is placed in the hands of the railway companies, and as they admit that the franchise is a reasonable one, it is to be hoped that there will be a period of electric street railway construction that will place Chicago in this respect upon a footing with other large cities in the country.

Present Utility of Electric Motors on Railroads.

An interesting paper on the "Present Utility of Electric Motors on Railroads" was presented by David L. Barnes at the last meeting of the Western Railway club at Chicago. This paper, Mr. Barnes said, was "suggested by the recent propositions of the large electric companies to operate steam railroads by electricity, and by the 'tug-of-war' at the World's Fair some months ago, and its object is to show to what extent electric motors may be used in place of steam locomotives at about the same cost for operation, and to point out a few of the advantages of electric motors where the conditions permit their use."

Mr. Barnes describes the general features of the electric railway system, the apparatus employed in its operation and pointed out the special features in the several types of equipment. Of particular interest at this time is Mr. Barnes' view of the relative economy of the electric motor and steam locomotive. He says:

The efficiency of the line of conductors from the central station to the motors, where the plant is properly put in, ought to be 90 per cent., and the efficiency of the dynamos ought to be such as to give at the terminals of the dynamo a current that would represent 85 per cent. of the indicated power of the steam engine. The steam engines used ought to give a horse power for 15 pounds of steam per hour. Now, having this information, we are in a position to show the relative efficiencies of steam locomotives and electric motors so far as the cost of fuel is concerned, leaving aside for the moment all other costs that go to make up operating expenses, such as wages, repairs, interest on plant, etc.

If the same fuel is used on the steam locomotive as in the stationary boilers, and the fuel is assumed to be fair bituminous coal, then each pound of fuel will evaporate into steam about 6 pounds of water in the best steam locomotives, and 8½ pounds in a good stationary boiler.

The steam locomotive will generate a horse power for about 25 pounds of steam an hour when the locomotive is of the best type; hence, on this basis, a comparison of the economies of the two systems in the indicated power in the steam cylinders of both systems is 1.8 pounds of coal per horse power per hour in the stationary engines and 4.2 pounds of coal per horse power for the steam locomotive.

The steam locomotive uses the power directly; and there is no further loss that need be considered with this general comparison, but with the electric system there is a further loss of 15 per cent. in the dynamo and connections, 10 per cent. in the line, and 50 per cent. in the motors for switching, suburban and elevated railroad work, or 20 per cent. in the motors for lines having about 8 minutes between stations. The final result is an efficiency of about 38 per cent. between the cylinders of the stationary engine and the drawbars of the motors for switching suburban and elevated railroad work, and 61 per cent. for the longer line assumed.

The result in the fuel used will then be 4.7 pounds of coal used an hour in the stationary engine to get one useful horse power on the drawbar of the electric motor for short lines, which is practically the same as that required for the steam locomotive. For the longer line assumed the fuel required is 3 pounds an hour per useful horse power. This is based upon an ordinary fuel; with a better class of fuel, such as anthracite burned on large grates, the locomotive will do better workin proportion, and the difference in economy in weight of fuel will be in favor of the steam locomotive on short lines.

For elevated railroad work, where anthracite coal is used, the locomotive, if of the compound type, will not require more than 3½ pounds of coal per horse power an hour at the drawbar, and such fuel is better than the common bituminous coal that would be used in the stationary engines of the electric plant; hence, so far as the use of fuel is concerned in actual work on elevated railroads, there would be no saving in weight of fuel by using electricity, but when allowance is made for the loss of fuel while the engines are standing fired up during the day and night, it is probable that the weight of fuel per ton per mile would be very nearly the same for the steam locomotive as for the electric motor when the same fuel is used, and somewhat less for the steam locomotive when anthracite fuel is used for the steam locomotive and cheap bituminous coal for the stationary boilers of the electric plant.

The conditions as to the use of fuel and the kind of fuel vary so much that each case must be treated by itself, but for all practical purposes of comparison at the present time, it may be assumed that the same amount of fuel per ton mile would be used with the electric system as with the steam locomotives for short lines.

If the conditions are such that a cheaper class of fuel can be used in the central station than on the steam locomotive, there may be a considerable saving in cost of fuel, while there is no saving in weight of fuel. On the elevated railroads in Chicago, where the fuel costs about $7 a ton on the tenders, and the fuel for a central station could be purchased for $1.75, a saving in cost of fuel of 63 per cent. is possible. In this case allowance should be made for the difference in quality of fuel, which would reduce the possible saving to about 50 per cent.

In local suburban work and for switching, where the same fuel could be used on the locomotive as in the central station, there will be no saving in the cost of fuel, and if it were found that the locomotive required a somewhat better quality than the stationary plant, and if the stationary plant could use bituminous slack, say at $1.50 a ton, while the steam locomotive coal cost $2.20 a ton, the saving in cost of fuel would be 22 per cent. This again shows how the conditions which regulate the price of fuel control almost completely the saving in cost of fuel incident to the use of electric motors.

For long lines, with considerable distances between stations, the efficiency of electric motors is very much greater, but the loss of energy in transmitting the current is also greater; the gain in efficiency of the motors will, however, more than offset the increased loss in conducting the current; hence, for such conditions the electric system is somewhat more economical in fuel than for elevated roads, switching or local suburban service, where the same fuel is used for both systems. On the other hand the steam locomotive is also more economical during long continuous runs, and probably the average conditions for this class of work are such that the same weight of fuel would be used in either case per ton mile, and it is only where the conditions demand a higher priced fuel for the steam locomotive than for the central station plant that there would be any substantial saving in cost of fuel per ton mile by using the electric system at the present time.

The first cost of central station plants and conductors for long line work is so great per mile of track as to deter any steam railroad company from making an experiment of changing a large steam locomotive plant to an electric at present. The prices for this work are now so unsettled that it would be valueless to give any estimate of cost in this paper. Prices are dropping rapidly, and it would not be surprising if one year hence the cost of installing an electric plant for long-distance work would be only about one-half of what it was a year ago.

Only on short lines, where the traffic is crowded, is it now economical to substitute electric motors for steam locomotives. There will be no saving in cost of fuel where the same coal must be used in the stationary plant as is used for the steam locomotive, and a substantial saving in fuel cost will only be obtained where, as in elevated road work, the fuel is much more expensive for the steam locomotive than for the central station.

The repairs to the electric motors, the line conductors and the central station plant, added to the interest on the first cost, cannot be greater than the cost of repairs and interest on steam locomotives when there is heavy traffic, although the first cost of the electric motors is fully double. This will, perhaps, appear from the fact that less work is necessary to maintain the electrical apparatus than the steam locomotive under equally favorable conditions for both. Especially is this true where the feed water is bad and the locomotive boilers collect much mud and scale. On the other hand, if inferior electrical apparatus is used and some considerable experiment is required to get a safe insulation of the line conductors and to put the mechanism of the controllers and motors into good running shape, the cost of repairs and maintenance of electric motors for the first two years will be very much greater than for the steam locomotives. This has been the experience of street railroad lines that purchased electrical apparatus during the period of rapid development. One of the most prominent and largest street railroad systems of this country has had to renew more than half of the motors under the cars and make radical changes in the central station plant, mainly for the reason that a few years ago, at the time the apparatus was put in, the art was in a stage of rapid development, and when the more perfect and better apparatus was brought out the best interests of the company demanded that the devices first put in, although comparatively new, should be cast out.

For these and similar reasons estimates made as to the cost of maintenance and deterioration of electrical apparatus should include such changes as will probably be required in the apparatus due to the advance of the art. While it may be true, as sometimes claimed, that electrical apparatus of the best kind will last in good working order for a period of 50 years, yet it must be remembered that long before such a period is passed the apparatus will be out-of-date and will have to be replaced by more practical and economical mechanism.

It will appear from this perhaps that no railroad company should undertake the substitution of electric motors for steam locomotives without the most searching inquiry into all phases of the question. Each piece of apparatus should be carefully examined, not only as to its durability and efficiency, but also as to its stage of development. The difficulty with similar apparatus on street railroads should be considered, and in making the final comparison of relative costs of maintenance and operation a factor of 10 per cent. per annum should be added over and above interest cost and maintenance so as to include the cost of such changes as will probably be required on account of the progress in the art.

Railroads running through a thickly settled district and having to contend with complaints about noise and smoke may find it worth an additional expenditure to remove the cause thereof, and where a railroad company is compelled to use a high-priced fuel to get rid of smoke it will be found advantageous and probably cheaper to use electric motors at the present time.

It has been claimed that only one man is required on an electric motor at the head of a train, and therefore that there is a saving of one man per train when electricity is used, but this is only true when there is not a separate motor at the head of a train and where the cars are run as on the Intramural road and the conductor is on the rear platform of the front motor car ready to give assistance in case anything happens to the motorman. Where the motors are separated from the train, it is not considered safe to use only a single man at the front end, for reasons that are too plain to require discussion here. It is probable that many railroad managers would decide always to use two men at the head of the train whether there was a motor car or a separate locomotive.

The trolley wire system of conductors has been proved to be practical, and it is safe to introduce it at the present time. The third or conducting rail system can be so insulated as to be made practicable, but the experience with it is much less. The service on the Intramural road was too slow and light to settle this point for heavy traffic on lines where passengers must in emergencies alight on the tracks and employes must travel to and fro in making repairs. Perhaps the trolley need not be overhead; it may be at the side and covered so it cannot be reached by passengers from the windows or steps of the car, but the fact remains that the overhead trolley is the only system of conductors that has been sufficiently well developed to enable one to pronounce upon its practicability with certainty.

The first steam railroad of any importance to take up seriously an investigation of a plan to use electricity in the place of steam was the Manhattan Elevated in New York city. The motor was too small and not powerful enough, or at all adapted, to compete with the steam locomotives then in use, and the design was also inefficient. The maximum drawbar pull of the steam locomotive was about 8,000 pounds while that of the electric was about 4,000 pounds. The failure was a certainty from the start, and although so evident at the time to those who were well informed in locomotive practice, yet this case of failure has been used unfairly since to show the impracticability of electric motors for railroad work. The trial was the result of a lack of appreciation of the real conditions, and to cite the results as showing anything useful so far as power, cost or efficiency is concerned, is practically malicious.

After the Manhattan fiasco but little was done in heavy work for a long time beyond the production of a multitude of designs. In 1891 the Thomson-Houston company, now the General Electric company, brought out a switching locomotive. This motor weighs 21.5 tons on drivers and has been used considerably with good results.

The next designs of any real importance are the electric locomotives of the City and South London Subway in London, designed by Messrs. Mather & Platt, engineers, of Manchester, England. The weight on drivers is 10 tons. These motors are now doing very good work.

A locomotive built by the General Electric company for elevated railroad service and tried at Lynn in 1893 afterwards took part in the tug-of-war at the World's Fair, where it was so badly beaten by a steam locomotive of about its own weight as even to arouse the sympathy of steam locomotive advocates. The cause of the failure was neglect to study conditions and the results were so misleading as to need further mention here.

The weight of this locomotive on drivers is about 59,000 pounds. The weight of the steam locomotive against which it was tested is about 62,000 pounds on drivers. The electric locomotive has a short wheel base and the drawbar is much above the center of the axle. When the pull came the weight on one pair of wheels was reduced by the tipping tendency, and that pair slipped and in slipping the motor on that axle revolved rapidly, and acted like a dynamo, and shut most of the current off from the other pair of wheels and the locomotive was practically without power. Had the motors been connected up so that the current divided and went through each separately, then the remaining motor on the other pair of wheels, after one pair had slipped, would have given a substantial pull but not enough to overcome the steam locomotive. If the wheels had been connected up with parallel rods the results would have been quite different and if some heavy weights had been added to hold down the electric locomotive on the opposite end from the point of pulling the electric locomotive would undoubtedly have pulled more than the steam locomotive for the reason that the power of the electric motor is applied evenly, while the steam power is applied irregularly. In a test of this kind both motors should have practically the same weight on drivers, and parallel rods should be used if it is desired to bring out the superiority of the even application of power by the electric motor. With equal weight on drivers and parallel rods on both, the electric will probably always pull more at very slow speeds than the steam locomotive of equal weight.

The electric locomotives on the Liverpool overhead road are very successful machines, and their practical operation shows great efficiency. The weight on drivers is 15.4 tons. The motors are placed directly on the axles and without gears.

The Northern Pacific terminal road in Chicago decided several years ago to make an experiment with electricity, and after a long investigation the firm of Sprague, Duncan & Hutchinson of New York city, now dissolved, was employed to make designs and construct an electric locomotive rated at 1,000 horse power. The construction of the frames was undertaken by the Baldwin Locomotive Works. The electric motors were to be of the Westinghouse design and make. Part of the construction has been done but the work has been abandoned for the present. This motor was expected to weigh about 60 tons on drivers.

The largest steam or electric locomotive ever ordered from any manufacturer is that adopted by the B. & O. Railroad company. Six of this type have been ordered from the General Electric company of Boston for use in the Baltimore belt line tunnel. The weight on drivers is to be about 200,000 pounds. The work required is to move a 1,200 ton freight train over a grade a little less than 1 per cent. at the rate of 15 miles an hour, and in passenger service to move a 500 ton train over the same grade at 30 miles an hour. Each locomotive will also be required to act as a push engine when the regular steam locomotive is hauling a heavy freight train up a grade of 1½ per cent.

The electric motors and the method of control have been designed by W. H. Knight, member of the American Society of Civil Engineers, chief engineer of the railway department of the General Electric company. These parts are being built at the General Electric company shops at Schenectady. The frames, wheels and connections are being built at the Schenectady Locomotive Works from designs of the writer. The work on these motors is being rapidly pushed, and they will be ready for use before the tunnel is finished.

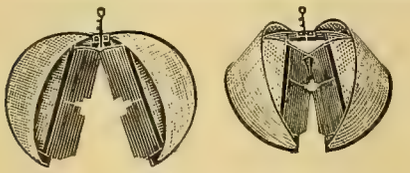
In a general way the foregoing gives the status of the electric locomotive question at the present time. In

the future the most rapid introduction will be for elevated railroads and for suburban lines and switching where the smoke nuisance must be abolished. For exceedingly high speeds, say 100 to 150 miles an hour, the electric locomotive has advantages that the steam locomotive can never have, but that there will be any real demand for any such speeds in the near future is doubtful. One derailment at one hundred miles an hour will dampen considerably the ardor of those who now clamor for the highest possible speeds. Even with the strongest wooden cars now built the loss of life in a collision or derailment at 100 miles an hour would be appalling. Metal cars and greater certainty of a safe clear track must be had before trains will be run at such high speeds as to require electric motors.

In the matter of men and tools for repairs railroad companies will need but few changes to care for electric locomotives. The maintenance of the conductors and central stations will probably fall to the road department and electric locomotives differ so little in running gear from the steam locomotive and are so simple in construction as to require no special knowledge to care for them. With the assistance of a good mechanical engineer, posted in electrical work, our railroad master mechanics can care for the electric locomotive quite as easily as the steam locomotive and the experience gained with the steam locomotive is absolutely essential for the economical maintenance of the electric locomotive, which locomotive must have practically the same cabs, air brakes, wheels, springs, draft gear, head light, running boards, pilots, axles, driving boxes, etc., as well as an equal corps of runners and assistants.

Metropolitan Specialties.

The Metropolitan Electric company, Chicago, is introducing a new arc lamp spark arrester, the advantages of which are pronounced, and the device is one of undoubted value. The Chicago spark arrester is made to fit any system, either single or double carbon lamps, and is fastened



METROPOLITAN SPECIALTIES.

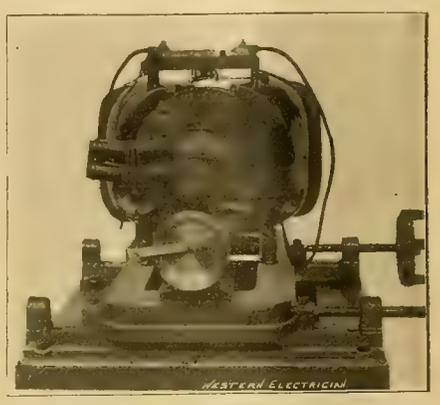
by an adjustable clamp to the lamp holder, inside or outside, and is arranged to open out, separating in the center so that once in position it is permanently fastened, and is easily opened to each side whenever necessary to trim carbons or change the globe.

The cover is arranged to automatically open and close as the carbon holder passes downward through the two mica plats. It is shown in both position in the accompanying illustratration. These plates are hinged and balanced, and close immediately after the holder has passed through. While held at an angle during the time that the holder is gradually being lowered by the consumption of the carbons, the device is so constructed that a draught is established, which draws the sparks away from the carbons, and the upper arrangement or hood of the arrester is so placed that the sparks cannot escape. Those who have examined the Chicago spark arrester predict its very general use.

A telegraph line is being established between Alleppo and Zor, Turkey.

Bain Arc Light Dynamo.

The accompanying illustration represents a constant current arc light dynamo with regulator, the invention of Foree Bain, and manufactured by the Great Western Manufacturing company, Chicago. The regulator is said to be very sensitive and at the same time very positive in operation, and it will maintain a constant current independent of the number of lamps in circuit. The machine, the company claims, may be run indefinitely on an absolute short-circuit without injurious results. The



BAIN ARC LIGHT DYNAMO.

device for the movement of the brushes is operated by means of a small belt connected with the armature shaft as shown in the illustration. By the rotation of a large pulley the ratchet bar is reciprocated, this ratchet bar carries a small rachet, which is held out of engagement with the rachet wheel by means of two eliptical springs on either side of the armature placed between two pairs of electro-magnets. The rachet wheel is connected by means of a shaft to a small pinion which engages in gearing cut on the rocker arm which carries the brushes.

The directing device, shown under the connecting board, which is mounted on top of the dynamo, consists of a small iron bar suspended immediately over the armature, and controls two contact devices, shown on the top of the connecting board. The contact device operates to short circuit both electro-magnets when the machine is working under normal conditions. The thumb nut, just below the connecting board, is connected by means of a bar and a spiral spring to the director bar, and tends to hold it in a position opposite to the position that the bar would assume by an increase of current in the armature. When the machine is first started the spring connected to the controller pulls the controller bar into position approximately parallel with the path of the current circulating in the wires of the armature. When the current in the armature has assumed a given value, which has been predetermined by the tension of the spring, the deflecting bar is deflected from a line parallel with the current in the armature to a line slightly at an angle therewith. Before it has been deflected, however, to the position described, the contact above the deflecting bar has been opened by the deflecting bar being out of position. When the machine is operating under normal conditions, an open contact above allows the current to pass through a pair of electro-magnets, on the right hand side of the armature, situated between the two pair of electro-magnets. The current circulating in this pair of electro-magnets attracts the armature toward them and engages the ratchet device in the rachet wheel and quickly gigs the ratchet wheel, in this case, in a clock wise direction, which moves the brushes to a point on the commutator corresponding to the highest potential. The director device may be adjusted at any time while the machine is operating so that it will maintain a constant current at any value desired within a range of 20 per cent. of its rated capacity.

FIG. 2. COTTON MILL ELECTRICALLY DRIVEN

Cotton Mill Electrically Driven.

The first instance of an entire cotton mill being electrically driven in this country is furnished by the Columbia Cotton Mills company, Columbia, S. C., which has equipped its plant in an interesting manner from designs furnished by the Stilwell-Bierce & Smith-Vaile company of Dayton, O. The power plant consists of two pairs of 48 inch cylinder gate Victor turbines on a horizontal shaft with a single 24 inch horizontal Victor turbine for driving the fire pump. The two pairs of 48 inch turbines are connected together, and at each end are connected to a generator of 700 horse power capacity of the General Electric company's manufacture. In Fig. 1 is shown an illustration of a dynamo directly connected to the Victor water wheels, and in Fig. 2 is presented a general view of the Victor wheels in position with direct connection made to a generator. The plans for the mill were furnished by Lockwood, Green & Co. of Boston, Mass.

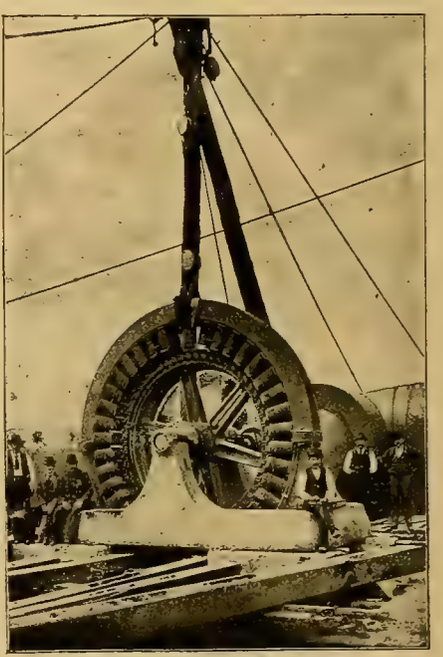


FIG. 1. COTTON MILL ELECTRICALLY DRIVEN.

Power Transmission at Taftville, Conn.

The first important application of electrical power transmission to textile manufacture has just been installed by the General Electric company at Taftville, Conn., the power being transmitted from Baltic to Taftville, a distance of nearly four and one-half miles. It is a typical transmission by the three-phase current, in which motors of the synchronous type are used not only to operate a cotton mill, but also the power station of the Norwich, Conn., Street Railway company.

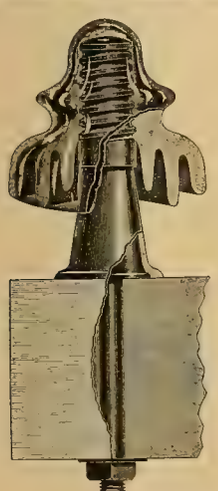
The Ponemah mills are located at Taftville, on the Shetugket river, about three miles distant from Norwich. The original mill was operated for nearly a score of years by water power taken directly from the river, and when the new mill was erected it was found necessary to drive it from two 350 horse power Corliss engines, the existing dam being insufficient in capacity.

In the basement of a rebuilt mill at Baltic, four and one-half miles from the Ponemah mills, are the wheel and dynamo rooms of the generating plant. The mill is of four stories, built of stone, and will presently be used as the Ponemah mills in the cotton weaving industry. Four hundred feet above the mill a fine stone dam, 525 feet long, has been thrown across the river. The effective head on the turbines is 32 feet, and the water available, even in the dryest seasons, is sufficient to furnish not less than

1,500 horse power. The turbines are belted to pulleys on the main line shaft, extending the whole length of the wheel room and continuing through the partition walls into and along one side of the generator room. There are three double 42-inch horizontal wheels and one double 27-inch wheel in the wheel room, the former developing 800 effective horse power each at 157 revolutions per minute, and the latter 300 horse power at 244 revolutions per minute. The belts pass obliquely upward to the pulleys on the line shaft, and the turbines are kept at speed by Schenck electric governors, which have proved themselves capable of doing very fair service.

FIG. 2. POWER TRANSMISSION AT TAFTVILLE, CONN.

The dynamo room, a view of which is presented in Fig. 1, is occupied by two 250 kilowatt General Electric three-phase generators, delivering current to the line at 2,500 volts. Each machine is provided with its own exciter, a three kilowatt bipolar dynamo. The three-phase machines run at 600 revolutions per minute, and are set so firmly on substantial foundations as to run with scarcely a perceptible vibration. The generators are connected to a common switchboard, and may be run in parallel whenever desirable. To this end the board is furnished with synchronizing apparatus, the acoustic synchronizer being mounted on the face of the switchboard, and the equalizing switch at the back. The most interesting novelties on this switchboard are the high voltage switches on the lower part of the board. These are mounted on marble bases with substantial barriers erected between the switch blades, so that the circuit at full load and voltage may be broken without the slightest danger of arcing across from point to point.



INSULATOR AND INSULATOR PIN.

The line is a good piece of construction work on substantial wooden poles placed 100 feet apart. The upper wires on the cross arms are of No. 0 bare copper and form the original three-phase circuit designed for the transmission. The wires on the lower cross arm are No. 0000 insulated wire, and are four in number. They were originally intended for a railway circuit, the generators for which were to be installed at Baltic to feed the Norwich street railway, but as the amount of copper necessary to do the work successfully appeared too great, the system was changed, a second three-phase generator and motor were added, and three of the four proposed feeder wires were utilized for the three-phase circuit. All are supported on the General Electric company's standard oil insulator, the fourth No. 0000 wire forming a convenient relay in case of accident to any of the others.

At Taftville the three-phase circuits are led into the basement of the new mill, where they drive two three-phase synchronous self-starting motors, identical in size with the generators at Baltic. These machines replace the two Corliss engines previously used. The motors start entirely unaided, coming up to synchronous speed in about fifty seconds from the time the current is thrown on. They are, like the generators, separately excited, the exciters being driven from the pulleys on the end of the motor shaft. The efficiency of the complete transmission at full load, from the power applied to the dynamo pulley to that delivered to the motor pulley, is just 80 per cent. Ordinarily, there is work enough for both motors, when driving the 1,700 looms in the new mill, operating the lighting plant and the three 80 horse power General Electric railway generators, installed in another part of the basement.

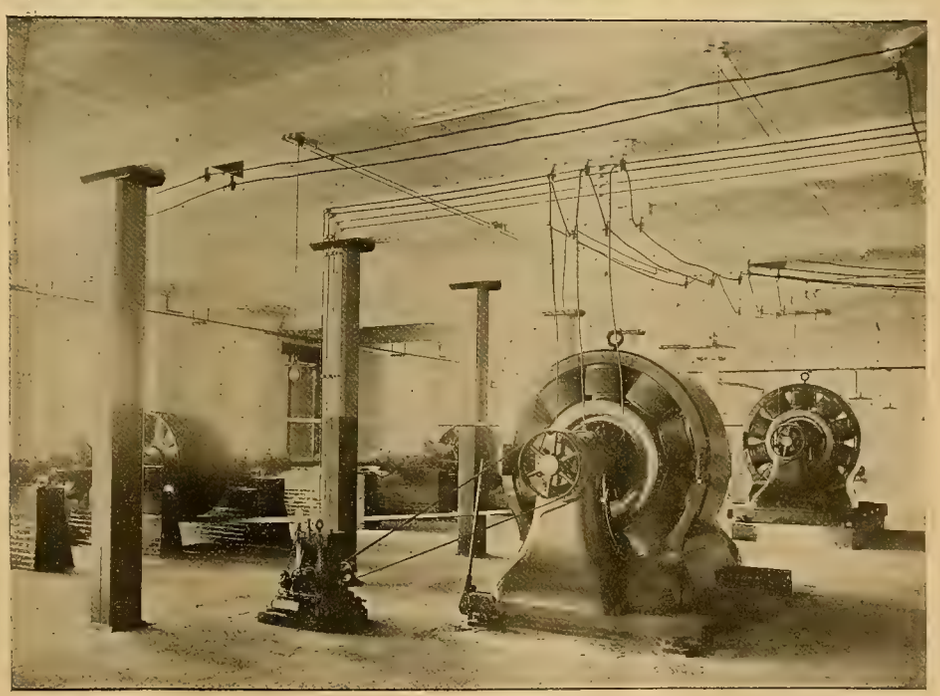
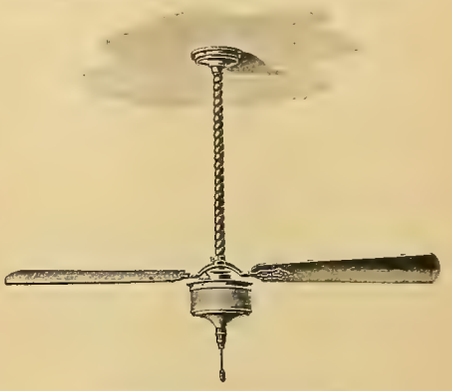


FIG. 1. POWER TRANSMISSION AT TAFTVILLE, CONN.

In Fig. 2 is shown the upper weave room of the new mill driven by these motors, and gives some idea of the work done by the motors and the extensive operations of the mill. This weave room is occupied at present in the production of delicate plain cotton goods for printing. The first motor was started more than two months ago, and the complete plant, entirely installed by the power and mining department of the General Electric company, has now been in operation for several weeks, entirely displacing the steam service, and performing its duties in a highly satisfactory manner. It is already attracting considerable attention among cotton manufacturers, and Mr. Taft, the owner of the mill, is in constant receipt of letters of inquiry regarding its operation.

Lundell Ceiling Fan Motor.

The Central Electric company, Chicago, is calling attention to its 1894 model of ceiling fan motor outfits. The apparatus which it proposes to push is of the Lundell manufacture, and, as seen by the accompanying illustration, it consists of a four pole field, carrying a stationary vertical steel spindle, attached firmly to an under spider. The armature is built up of the usual laminations of soft iron on a gray iron center, and are carried on a composition sleeve, which slips over the stationary spindle and rests upon a shoulder at the bottom. The armature sleeve also carries the holder for the fan blades. A very simple device is employed for attaching the motor to the ceiling. It is a flexible insulated connection, and its use will be apparent on inspection. Over the hanger pipe is placed an ornamental piece of brass rope tubing. Lead wires from the motor are furnished of sufficient length to pass up through the hanger pipe to the outlet at the top over the canopy. A single pull switch is attached to the bottom spider of the motor. The Central Electric company is now located in its new home, 173-175 Adams street, Chicago.



LUNDELL CEILING FAN MOTOR.

Insulator and Insulator Pin.

The accompanying illustration shows a representation of an indestructible insulator pin and triple petticoat insulator. The insulator pin, in addition to being practically indestructible, possesses the advantage of being easily attached, and, instead of splitting the cross-arm, as is often

the case in the ordinary driven wood pin, rather tends to preserve it. These pins will withstand a strain of 1,800 pounds, while oak and locust pins break at 700 and 900 pounds respectively. The triple petticoat insulator shown, as well as the pin, is manufactured by Fred M. Locke & Co., Victor, N. Y., and is especially suited where high insulation is necessary, as it has an unusual length of insulating surface. This insulator has been largely used upon high tension lines, up to 10,000 volts, and another style is made, which, it is claimed, can be used with voltages up to 35,000.

New Westinghouse Railway Equipment.

The Westinghouse No. 12 single reduction railway motor is the direct sequence of the company's No. 3 motor of the same type, and, while retaining the superior qualities, is put upon the market to meet the demand under special conditions for a lighter motor, and especially one that has less weight upon the car axles. The new motor, as shown in Fig 1, appears to resemble the No. 3 single reduction motor without the iron frame which serves as its

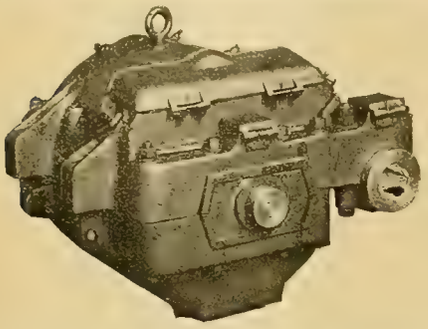


FIG. 1. NEW WESTINGHOUSE RAILWAY EQUIPMENT.

support. The absence of this frame reduces the weight of the new motor without diminishing its rigidity. The armature, of which an idea may be gained by reference to Fig. 2, which is an illustration of the motor casting, containing a single reduction railway motor with the armature in the lower field, is of the drum type and wound with machine-made coils. Each of these coils consists of heavy insulated wire, wound in rectangular form. The two longer sides of the coil are inclosed in cells of special insulating material, the whole being then wrapped with insulating tape of a superior quality. The coils are connected to the commutator segments so that the armature winding has only two circuits. The commutator segments are of the highest grade drop-forged copper of uniform hardness, and the mica insulation is of the best quality.

The field consists of four pole pieces projecting radially inward from a circular yoke or ring, which parts in a horizontal plane through the shaft. In order to secure rigid-

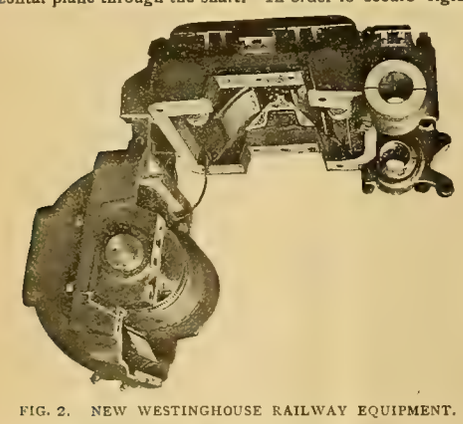


FIG. 2. NEW WESTINGHOUSE RAILWAY EQUIPMENT.

ity of construction, the two lower pole pieces, half of the circular yoke and end plates, are made in a single solid casting, which secures strength and at the same time completely protects the lower half of the motor. The field coils are wound and insulated in the same manner as in the No. 3 motor, although the capacity of the winding has been somewhat increased, and the insulation is made, if possible, even more thorough. The two brush holders, 90° apart on the top of the commutator, are held in position by a frame, which is so designed as to constitute a part of the end of the upper field, and, together with a lid, completely incloses the commutator end of the motor, and entirely protects the inner parts. By reason of the increased strength of the upper field yoke it is possible to suspend the motor directly in the line of its center of gravity, by means of suspension bars which run parallel to the sides of the truck and have their ends supported upon spiral springs. By reason of improvements which have been introduced and of a more efficient utilization of the iron in the fields and armature and of the copper in the windings, it has been possible to effect a material reduction in the weight of the new motor. This has been done, of course, only so far as it is believed consistent with a margin of mechanical strength adequate to meet the severe conditions of electric traction.

In Fig. 3 is shown a reproduction of the controlling apparatus. This apparatus also is very similar to an older type used by the company. It is a series multiple controller, having two removable handles, one for controlling the speed and the other the direction of travel of the car. The electrical combinations of the motors made by the new controller are improved over those of the earlier type, in that the motors divide the work equally, and the car starts more easily and attains its maximum speed more smoothly.

The usual accessories of an electric railway system have been designed and worked out with considerable care, some of the apparatus being of marked improvement over the old form. One of the best of these is the lightning arrester recently developed by A. J. Wurts, which was recently described and illustrated in these columns.

Electricity for the Metropolitan "L" Road in Chicago.

The decision of the Metropolitan West Side Elevated Railroad company, Chicago, to adopt electricity as the motive power for its road is one that is of great interest to engineers and railway men in this country, and the announcement is one that will be received with gratification. The capitalists who are back of the road held a meeting in New York last week, and, after receiving the reports of the engineers who

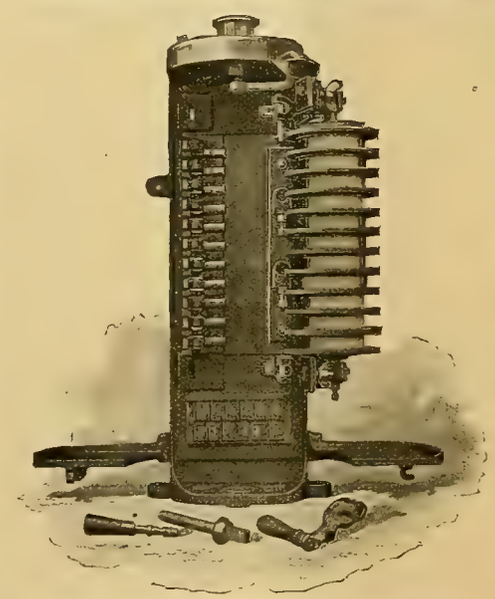


FIG. 3. NEW WESTINGHOUSE RAILWAY EQUIPMENT.

have been employed in investigating the merits of electric power for elevated roads, decided to use electricity. It has been generally known for some time that the company has been inclined toward its use, but no definite action has been taken until the meeting last week. This decisive action is regarded as very important by electrical men, for the comparative merits of steam and the chosen power were carefully investigated, and the victory of electricity is based upon the confidence of the company's engineers in greater economy to be gained by its use. It was also decided at the New York meeting to use electric power from the start. This was something of a surprise to the Chicago representatives of the company, who had been given to understand that 20 steam locomotives would be leased from the Alley "L" road to haul the first trains. Several systems have been investigated, but as yet none has been selected. This decision, of course, must soon be made as the road is practically completed west of the Chicago river, and it is the intention of the company to open the road for traffic as soon as possible. By discarding steam some delay will naturally be encountered, as it will require some time to build and set up the large generating machinery which will be necessary for such work. The prospects for electric elevated roads in Chicago are now very bright, that power having been decided upon by the promoters of the proposed North Side road. The Metropolitan road will be the first elevated road of importance in this country to make such a radical change from existing practice, and the installation and operation of its motor system will be carefully watched by many large cities which will undoubtedly avail themselves of the experience and knowledge gained in a practical manner upon the new Chicago road.

Electric Railroad Between New York and Washington.

A company composed of New York and Philadelphia capitalists has been organized, it is reported, to build an electric railway from New York to Washington. The tracks, according to the scheme, will be elevated to avoid grade crossings and two main tracks will be constructed. A third or center rail will transmit the power instead of an overhead trolley system. Vestibuled cars fitted like Pullmans will be run. The company says it can run the cars at the rate of 200 miles an hour, and a number of other wonderful innovations are promised. Congress will be petitioned to grant a right of way in the District of Columbia. If a maximum speed of 120 miles an hour is not attained all rights and privileges will be revoked. New York, New Jersey, Pennsylvania, Delaware and Maryland legislatures will also be asked for rights of way. The line will run by way of Philadelphia and Baltimore.

Postponement of the Celebration at Niagara Falls.

The inaugural celebration, which was planned to have been held about June 1st at Niagara Falls to mark the opening of the power transmission plant, and to which it was intended to invite all the prominent electricians and men interested in similar undertakings in this country, has been postponed until the month of October. It is said that the manufacturers of the electrical apparatus agree to complete the machinery and set it up by that time, and the formal celebration of the opening of the work is now definitely set for October. It will be an event of great importance to the scientific world, and plans are being formed to make it a gathering of notable men.

Injunction Confirmed in the Oconto Lamp Case.

In the United States Circuit Court of Appeals for the seventh judicial circuit, Judge Jenkins on May 1st filed his opinion in the case of the Electric Manufacturing company and others, appellants, against the Edison Electric Light company and the Edison General Electric Light company. The case was an appeal from the Circuit Court of the United States for the eastern district of Wisconsin, which had granted an injunction restraining the Electric Manufacturing company from manufacturing or selling incandescent lamps that infringed the Edison patent. It will be remembered that the "Goebel" defense was relied upon mainly in this action. The decision of the lower court was sustained, and the grounds upon which this was done are summarized in the last paragraph of the opinion, which says:

Without assuming to say that the story of this invention is untrue, and without designing to suggest what result should be reached upon final hearing, we are compelled to say that the story is surrounded by such an atmosphere of improbability that until it shall have been thoroughly sifted and sustained upon final hearing, the claim ought to be permitted to invade the monopoly accorded to another for the same invention, whose claim has passed safely the ordeal of judicial scrutiny. We think therefore the court below well held that the patent of Mr. Edison should be protected from invasion *pendente lite*.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 30.—Last Thursday the Legislature passed the Chamber of Commerce rapid transit bill. While it is a subject for gratification that a step at least has been taken in the direction of rapid transit for New York, it is to be regretted that the legislative body of the state of New York saw fit to add to a bill which seemed to possess almost unanimous public approval, amendments which not only will tend to delay decisive action, but which cast upon it the shadow of the doubt of its constitutionality. The clause which has provoked the most severe criticism is that which provides for the referendum or the submission to the people of New York of the question of the city constructing the road. However, the bill has passed, and is now in the hands of the governor. It was fortunate enough to escape many vicious amendments that threatened its existence for a time, and, upon the whole, as far as its spirit is concerned, it is satisfactory to the large majority of New Yorkers. It provides for the creation of a commission consisting of the mayor and comptroller of the city, the president of the Chamber of Commerce, ex officio, and William Steinway, John H. Starin, Seth

Low, John B. Claflin and Alexander E. Orr. The commission will have authority, after adopting plans and obtaining consents for the construction of rapid transit roads, to offer the franchise for sale, in case it finds any prospect that private capital will undertake the work. It is only in case the commission decides in favor of construction at municipal expense that this question will have to be submitted to a vote of the people and answered in the affirmative before the plan can be carried out. If the bill escapes a legal challenge as to its constitutionality, and if Governor Flower signs it, rapid transit in some shape or other may assume a tangible form, for there is no reason to doubt that the people will vote almost unanimously for it. Electricity is soon to give rapid transit to Chicago; it is to be hoped that New York will be as fortunate.

In the suit of John Anderson, an ex-member of the Produce Exchange, who brought an action against John W. Mackay in the United States Circuit Court before Judge Shipman for $100,000 for services as manager of the Commercial Telegram company and his interest in the stock of the company, the jury rendered a verdict last week in favor of Mr. Mackay. Mr. Anderson, it was alleged, entered into a contract in 1885 with Edward Stokes, who was then the owner of the Commercial Telegram company, by which he was to receive a salary as manager and one-fourth of the company's stock. On January 1, 1889, Mr. Stokes sold the stock to Mr. Mackay, and one of the considerations of the purchase, it was alleged, was that Mr. Mackay was to assume all liability for the contract entered into between Mr. Anderson and Mr. Stokes. Mr. Mackay testified that he merely said to Mr. Anderson that he would do whatever was just and right in the matter when he inquired into the case.

The construction of 100 miles of new trolley lines in Brooklyn by the Nassau Electric Railway company, which is known as the Flynn road, will be begun in a few days. Articles of agreement for the building of the road have been signed by Albert L. Johnson, representing the Johnson company of Johnstown, Pa., and J. W. Edwards, representing E. S. Wilson & Co., bankers, No. 33 Wall street. Over $6,000,000, it is estimated, is involved in the transaction. The new lines will run from the several ferries to Fort Hamilton, Bath Beach, Benson Hurst, Manhattan Beach, Sheepshead Bay, Canarsie and Flat Lands. A year or more will be required to complete the system.

The International Telephone & Telegraph company was incorporated on April 28th to construct a telephone and telegraph line commencing at Gouverneur, St. Lawrence county, and running through Wegatchie, Oxbow, Rossie Paper Mills, Edwardsville, Bryerhill and Morristown, with the principal office in New York city. The capital stock is $5,000, and the directors are A. L. McCrea, Jr., Gouverneur; William J. Arkell, Bernard Gillam and W. F. Cook, Canajoharie; Bartlett Arkell and Alfred Rindskopf, New York city, and F. H. Ludlow, Brooklyn.

The new electric line between Newark and Jersey City, which was opened a few days ago, has proved to be a great success. Many thousand passengers between the two cities were carried last Sunday. The rain in the morning diminished the travel, but when the sky cleared in the afternoon all of the cars were crowded in both directions. The eastward travel was so largely in excess of the expectations of the Consolidated Traction company that it became necessary during the afternoon to run all of the local cars on the Newark end of the line through to the ferry instead of stopping them as usual at the plank road bridge over the Passaic. Hereafter better provisions will be made, both in cars and power to propel them.

W. F. O.

Milwaukee, Wis.

MILWAUKEE, April 28.—Only a few weeks ago the Wisconsin Telephone company was involved in a row with the druggists of the city. Now, after a brief period of peace, the company is at war with all its patrons, including the druggists, or rather all the patrons are at war with the company. A few days ago the company issued a circular containing the announcement that it had been decided to charge subscribers two cents a call on all calls in excess of 250 a quarter—1,000 a year. The circular stated that at the conference with the committee representing the druggists, who had protested against the placing of toll stations in their stores, it was agreed to base rates upon the actual service performed at each telephone. It is explained that the action is based upon a new interpretation of the contracts between the telephone company and its patrons. Under the system that has been in vogue the charge has been $90 a year for a metallic service within a certain radius of the exchange. This sum paid for 1,000 calls. The rate for each succeeding year was fixed by the number of calls during the preceding year, $10 being added to the rate for every 500 calls in excess of the original 1,000 or for every major fraction of that number. Superintendent Cottrill points out the fact that by this method the subscribers pay only for service actually rendered. For instance, if the subscriber exceeds the limit by 360, he will have to pay $7 20 only, whereas by the old system he would have to pay $10.

Nevertheless the patrons of the company are up in arms. They are very indignant and declare that they will get along without telephones rather than submit to what they are pleased to term an outrage. Secretary Henry R. King says that the Manufacturers' association will take up the matter promptly and decisively. President Hansen of the Merchants' association declares that if the new rule be enforced there will not be many telephones used in the city. Manager Mackinnon of the Merchants' association, states that the company's action is only a new dodge to prevent the use of telephones by outsiders. If the contracts are enforced on that basis, he says, it will be cheaper to use the mail and to pay for special messenger service. Officials of the E. P. Allis company state that if two cents be charged for every call in excess of 1,000, telephones will too expensive for use. Banker John Johnson says that the man who does not use his telephone more than three times a day—the daily proportion of 1,000—has no need of it at all. Ex-President Chapin of the Chamber of Commerce, estimating on the basis of 320 working days a year and $120—his annual rental—says he pays twelve cents a call, whereas he can send ten words to Chicago for five cents.

The Board of Public Works has issued a peremptory order to the Milwaukee Arc Light company to remove overhead wires strung by the company, in disobedience to a city ordinance, from Third street to the Liederkranz hall on Fifth street and along West Water street from State street to Grand avenue. On March 15th the company was directed to remove the wires, but it failed to do so. The board claims that on March 22d Oscar Altpeter, the secretary of the company, was requested to call at the board's office in regard to the matter, but failed to appear, and the board finally issued an order informing the company that unless its wires were removed within twenty-four hours they would be cut down by order of the board. This decisive action brought the company to time. Its officers appeared before the board, expressed their willingness to comply with the order, but stated that to do so at once would be a hardship. The board finally consented to allow the company 15 days in which to comply with the order. The company is the successor of the old Milwaukee Light & Power company, whose plant it purchased just as it was about to be sold under legal proceedings. The personnel of the new company and that of the old one are very similar. The ordinance which the company is charged with violating prohibits the overhead stringing of wires.

Milwaukee electricians and railroad men were very much interested in a car that was exhibited here a short time ago by the American Electric Railway Lighting company. The car made an experimental trip over the St. Paul railroad, and it is said to have been successful. The car generates electricity by the motion of the axles and in addition to furnishing sufficient power to light the car while it is moving its stores enough power to light the car for four hours after the car stops. The generator is attached to the axle of the car. The inventor of the system is Robert Hines, and the appliances which are used are said to weigh less than 1,000 pounds.

In his annual report Superintendent Kleinsteuber of the police alarm telegraph states that of the 133 miles of wire that constitute the system forty miles are now underground and that considerably more will be buried during the present year.

The Edison Illuminating company has made a material reduction in the price of incandescent lighting, and it is now claimed that electric light here is as cheap as gas. The cost of such light is one cent per hour for a lamp of 16 candle power. Heretofore the discount has been 25 per cent. on monthly bills of $50 or less and 10 per cent. on bills of more than $50. The discount is now 25 per cent. on monthly bills of $25 and 50 per cent. on monthly bills of $50 and upward. The discount will be allowed only when the bills are paid within ten days after date. The company is now furnishing about 15,000 incandescent lamps and the wires radiate from the power house on River street for a distance of a mile. As soon as possible the service will be extended to the residence district.

Henry C. Payne, the local head of the Milwaukee Street Railway company, furnishes some interesting figures concerning street railway earnings. On the first day of the present month, he states, the earnings were exactly $407.70 less than for the corresponding day last year. The earnings for April 2d showed a falling off of $240.88 as compared with April 2, 1893. The earnings for the last week in March were $1,093.02 less than the earnings for the corresponding week last year. Mr. Payne recently intimated that at the time that the Northern Pacific Railroad company passed into the hands of receivers the Milwaukee Street Railway company nearly shared the same fate. Such a misfortune, he stated, was just averted and that was all.

Work on the electric railway at Green Bay, which was stopped last summer, is now being pushed to completion. The line, it is expected, will be in operation in about six weeks. The company has been incorporated under the name of the Fox River Electric Railway company, and it is intended to extend the system to Depere and to Fort Howard.

A planing mill which is being built at Depere will be operated by power furnished by cable from the Electric Light & Power company's plant. C.

PERSONAL.

Prof. Sidney H. Short of Cleveland called on his Chicago friends last week.

C. E. Stump of New York, general manager of the *Street Railway Gazette*, was in Chicago last week.

F. P. Little, president of the F. P. Little Electrical Construction & Supply company, Buffalo, N. Y., was in Chicago last week.

S. Davies Warfield has been appointed postmaster of Baltimore. Mr. Warfield is a well-known manufacturer of electrical appliances in Baltimore.

Warren L. Beckwith, late of the General Electric and Chicago Edison companies, has opened offices as a stock broker in the new Stock Exchange building, Chicago.

P. M. McLaren, general agent of the Abendroth & Root Manufacturing company, New York, is looking after the interests of his company in the West and was in Chicago this week.

NEW INCORPORATIONS.

International Electrical Supply & Manufacturing company, Detroit, Mich.; capital stock, $500,000.

Chihauhau Electric Light & Power company, Chicago; capital stock, $100,000; G. W. Dupee, Chicago.

Bluestone Electric Light company, Coopers, W. Va.; capital stock, $50,000; J. B. Bowen, Coopers, W. Va.

Electric Telegraph company, West Chester, N. Y.; capital stock, $10,000; A. W. Keplier, West Chester, N. Y.

St. Louis Electric Brake company, East St. Louis, Ill.; capital stock, $2,000,000; J. L. Black, East St. Louis.

Lock Haven Electric Street Railway company, Lock Haven, Pa.; capital stock, $100,000; Luther M. Patterson, Lock Haven, Pa.

Wisconsin Electric Dynamo company, Milwaukee, Wis.; capital stock, $50,000; to manufacture dynamos and electric supplies; G. Podoll, Milwaukee, Wis.

New Jersey Postal Telegraph & Telephone company, Newark, N. J.; capital stock, $500,000; to construct and use lines of wire between and in the different cities of the state; J. A. McClary, Rahway, N. J.

ELECTRIC LIGHTING.

There is talk of an electric light plant being erected at Etonton, Ga.

An electric light plant will probably be established at Luling, Tex.

There is a project to establish an electric light plant at Holly Springs, Miss.

The Vallejo, Cal., electric light plant, was sold at auction by the sheriff a short time ago. It was bid in by ex-Senator James McCudden, of Vallejo, for the sum of $2,850. It is said that it will be overhauled and enlarged.

The announcement is made in correction of a former statement that the Co-operative Electric Light company, Chicago, has given a trust deed of $400,000, running for 10 years at six per cent. to the Royal Trust company secured by the company's plant at 359 North State street.

ELECTRIC RAILWAYS.

The contracts have been closed for nearly all the material required for the North Chicago electric railway equipment. The General Electric company will furnish the car equipments, 25 in number, using the G. E. 800 motor. The Siemens & Halske Electric company will supply four 550 kilowatt generators. Brownell accelerator cars and Brownell trucks will be used. Washburn & Moen will furnish the wire, and the Johnson company the rails.

J. K. Tillotson, president of the Toledo, Maumee & Perrysburg Electric Railroad company, Toledo, O., asserts that cars will be running on the line by June 1st. All contracts have been let, and large gangs of men are now grading the roadbed. The Westinghouse Electric & Manufacturing company will furnish the cars with motors and the electric apparatus for the station houses. The company will use the new style of steel motor. The Craighead Engineering company of Cincinnati has secured the contract for overhead construction, and the rails will be furnished by the Carnegie Steel company.

MISCELLANEOUS.

Wilson & Jackson, general contractors, Chicago, have removed their offices to 1539-1540 Monadnock building.

A German firm recently brought out electrical meters, says *Invention* of London, which, instead of reading in ampere or watt hours, gave directly the price of electricity consumed, thus enabling the consumer to read the meter himself. It appears, however, that such meters are not allowed in Germany, and it is suggested that they might be made with two scales, one reading in electrical units and the other giving the plain money value.

A new application of electrical energy has just been made at Brisbane, Queensland, by the Pine River Dairy company, which has installed an electric plant for butter making. A small motor is employed to drive a large concussion churn and a circular butter-worker, with the smaller accessories. The entire absence of heat and smell in motive power for such an industry as butter-making is of manifest advantage, and the new departure is said to have created considerable interest in the colony.

Some of the daily newspapers display a surprising knowledge of the advancement that is being made in the world. The possibilities of electricity as a means of motive power evidently overpowered the editor of an Illinois paper recently, for he tells his readers that "electricians have now taken hold of the problem of rapid transit, and within five years electric roads will be built up back-county creeks and through forests." Yes; now that electricians have decided to devote their energies to "the problem of rapid transit" undoubtedly the creeks and forests will be invaded by the clang of the trolley car and possibly, if the editor is wide awake, he may by their aid get out of the woods and learn that electricians have also "taken hold" of several other prob'ems, such as making light and talking over long distances to each other by the aid of a wire. The positive prophecy made by the writer of the quoted paragraph is but another evidence of the fact that "the trolley must come."

TRADE NEWS.

C. M. Turnquist, 23 Lakeside building, Chicago, dealer in electrical supplies, is offering special inducements on a stock of telephones and fan motors, as well as a number of other specialties.

J. F. Rogers & Co., New York city, have placed the order for a new industrial school building at Havana, Cuba, with the Berlin Iron Bridge company of East Berlin, Conn. The building will be 15 meters wide and 48 meters long, constructed entirely of iron and cement.

The National Chemical Works, Cragin, Ill., manufacturers of Bonnell's Nubian system of scale prevention in boilers, have taken a number of large orders of late. This system has met with favor among electric light plants, as it can be prepared to suit individual requirements. A pamphlet with further information will be sent to those interested upon request.

The street railway, electric light and power, and the electrical supply and construction editions for the first quarter, 1894, of the Buyers' Reference company's publication contain much that should interest and be of value to the electrical buyer. Many new ideas in electrical goods are illustrated and described, and the lighting section in particular is full of good specialties.

The Economy Heat, Light & Power company of Scranton, Pa., has contracted with the American District Steam company of Lockport, N. Y., for the construction of a steam heating and power plant, with the underground mains of the Holly system, to cost $150,000. The officers of the company are: President, William Connell; vice-president, Lemuel Amerman; treasurer, Lieutenant-governor Watres; secretary, I. H. Burns. A large steam heating plant is to be constructed in Scranton, Pa.

Under the comprehensive title, "Infinity," the Standard Underground Cable company has issued an amusing illustrated circular, said to have been "published in Pittsburg in great fear by the author." This is one of the few advertising publications that are read with appreciation for their own sake, as the cuts are funny and the jokes good. The company's representatives state that they are not in business for their health, as "we have 'directors' who attend to that branch of the trade." The seeker for information is also told that "'Dead grounds' are easily located; go to a cemetery. We use a galvanometer." The accompanying picture shows a burying ground, with a carefully tended grave marked by a slab "sacred to the memory of underwriters' wire." Among the other pictures are unique representations of "a small male megohm in search of water (very rare);" a volt which "came from a bunch of ten thousand and was taken at random, with no attempt to secure one with greater beauty than others," and "the only ampere ever taken alive without the aid of a net." In the case of the volt comment is made on the curious position of the creature. There are other funny features; and everyone who receives one of these circulars is assured of a hearty laugh at least. The name of the author is not given, but there are suspicious indications pointing to the handiwork of the popular western manager of the company, F. E. Degenhardt, 542 Rookery, Chicago.

BUSINESS.

Horne & Martin, Chicago, have removed their offices from the Home Insurance building to 1513 Old Colony building.

The Charleston, Ill., Thomson-Houston Electric company will start a 110 volt day circuit about the last of May. F. A. Brooks, secretary and treasurer of the company, announces that no motors have as yet been sold and that the field is open.

A. L. Daniels, traveling agent for the Miamisburg Electric company, Miamisburg, O., was in Chicago last week. Mr. Daniels reported having sold over 4,500 Imperial and Cartridge dry batteries in less than a week, and that the outlook for more orders seemed to be bright.

The Pumpelly-Sorley Storage Battery company, Chicago, recently closed the contract for a plant of 56 400-ampere hour cells for the Kent apartment house at Forty-third street and Calumet avenue, Chicago. The company has also sold a number of other smaller installations in the city.

In answer to the advertisement of the assignee of the Ansonia Electric company, Chicago, bids have been received by him for the good will, stock, electrotypes and catalogues, the highest being $8,750, made by Thomas Wallace, Jr. The assignee will hold this bid open until May 16th, and an effort will be made to have the bid raised.

The new electric light and power station for the Brush Electric Light company at Baltimore, Md., will be one of the finest in the southern states. The boiler room is 83 feet wide by 129 long. The dynamo room is 130 feet square. The roofs are designed and built by the Berlin Iron Bridge company of East Berlin, Conn., and are made entirely of iron, covered with the company's patent anti-condensation corrugated iron roof covering.

The Green economizer is being pushed to such an extent that it has been attracting attention in many parts of the country, and an example of some of the work that it is doing in Montreal may explain a degree of its popularity. Water is taken from the hot well at 90° and raised as high as 315°. When it is considered that this is done through the waste products of combustion it will readily be seen why so many large power houses are investigating this apparatus.

Col. S. G. Booker, of the Hayden-Booker Manufacturing company of St. Louis, left home on April 25th to make an extended business trip through the South. He will visit New Orleans, Vicksburg, Memphis, Birmingham, Nashville, Chattanooga, Louisville and other prominent cities. As the Hayden-Booker company has just finished samples of its novel and complete line of battery goods, Col. Booker starts well equipped to demonstrate that his company intends to have a good big share of the battery business.

W. L. Arnold and George D. Rosenthal, the two well-known and energetic managers of the St. Louis office of the General Electric company, have reason to be proud of the recent $20,000 contract for fixtures which they made for their company with the new Planters' Hotel in St. Louis under strong competition. The total contract amounted to about $60,000. Two 75 kilowatt General Electric machines and one 25 kilowatt machine will be installed, and the wire used will be the U. S. brand, made by the General Electric company.

Kohler Brothers, Chicago, have made an important addition to their business by securing the agency of the Walker Manufacturing company of Cleveland, for the West. The territory which Kohler Brothers will cover includes Illinois, Western Michigan, Western Indiana, Wisconsin, Iowa, Kansas, Missouri, Nebraska, Colorado, Minnesota, Montana, North Dakota and South Dakota. The Walker company is well known as a manufacturer of cable machinery and it has recently engaged in the manufacture of electric railway and power apparatus. Kohler Brothers are well known in the electrical field and the arrangement will undoubtedly prove advantageous to both parties. Kohler Brothers will continue to represent the Eddy company in Chicago.

Dillon & Haugh is the firm name for a partnership recently formed between T. J. Dillon and A. W. Haugh of Indianapolis, Ind., for the purpose of carrying on a general electrical contracting, manufacturing and repair business. Mr. Dillon already has a local reputation as an electrical contractor, and the Dillon suspension bars for electric lights are well known to electric light men. Mr. Haugh is an experienced mechanic and will attend particularly to the practical side of the business. Dillon & Haugh are prepared to sell the Dillon suspension bars and install electric and water motors, ventilating and exhaust fans, etc., and will also do repair work. The office and factory is at 9 West Garden street, Indianapolis.

C. M. Giddings, who has been for the last six years in charge of the Sioux City Engine Works, building up a fine trade for that concern, deciding to return to his former state, as a better place for manufacturing, has recently connected himself with Brownell & Co. of Dayton, O., manufacturers of boilers and engines. The firm has bought the exclusive right to manufacture under his patents, and has established a department of engineering under the supervision of Mr. Giddings. Brownell & Co. will make a speciality of high grade automatic engines, both simple and compound, and have purchased the entire stock of drawings, patterns, finished and unfinished automatic engines of the Sioux City Engine Works. These engines are well known in the trade as the Russell single valve automatic engines. Mr. Giddings was in charge of the engineering department for four of the seven years he was with the Sioux City Engine Works and while there designed and patented his popular governor and valve. The highest possible grade of workmanship and finish will be maintained in these engines, which have already obtained such a high standing for their close regulation. Brownell & Co. have recently added to their boiler shop equipment, a set of 20 foot rolls 18 inches in diameter, capable of rolling the heaviest plate and making 20 foot boilers in two sheets. This, with the special machinery of their own design and make, put them in the front rank of well equipped boiler manufacturers.

ELECTRICAL PATENTS.

Issued April 24, 1894.

518,604. Electrical Calculating System. Herman Hollerith, Washington, D. C.

518,654. Electric Arc Lamp. Rudolph Segerdahl, Chicago, Ill.

518,667. Electric Lock. James Eldon, Lock Haven, Pa.

518,673. Electrical Device for Towing Vehicles. Thomas P. Milligan, South Orange, N. J.

The towing device comprises a fixed rail located over the path of the vehicle and a carriage traveling thereon and carrying an electric motor, which imparts motion to the carriage through the agency of a gear wheel engaging a rack. The carriage is connected with the vehicle by a rope or chain, and a pull rope connected with a switch carried upon the carriage also extends to the vehicle, whereby the operation of the motor may be controlled.

518,693. Controlling Switch for Electric Railways. Philip Lange, Newark, N. J., and Benjamin G. Lamme, Pittsburg, Pa.

518,695. Conduit Electric Railway. Charles A. Maynard, Springfield, Mass.

518,719. Electric Arc Lamp. Carl Hoffmann, Berlin, Germany.

518,738. Apparatus for Neutralizing the Effects of Self-induction in Alternating Current Circuits. John F. Kelly and Cummings C. Chesney, Pittsfield, Mass.

The primary of a transformer is connected in parallel with the alternating current circuit, and a condenser is included in circuit with the secondary, the transformer and condenser being so proportioned as to produce in the current in the primary of the transformer a negative lag for neutralizing the effects of self-induction in the working circuit.

518,739. Means for Reducing the Apparent Energy Supplied to Alternating Current Magnets. John F. Kelly, Pittsfield, Mass.

In inductive relation to the primary or energizing coil of the electro-magnet is provided a secondary coil, a condenser being included in circuit therewith, and of a capacity less than that required for neutralizing the self-induction of the secondary for a given frequency.

518,740. Alternating Current Dynamo. John F. Kelly, Pittsfield, Mass.

518,742. Telephony. William C. Lockwood, New York, N. Y.

518,756. Armature for Dynamo-electric Machines or Electric Motors. Thomas H. Hicks, Detroit, Mich.

518,768. Dynamo-electric Machine or Motor. Andrew L. Riker, New York, N. Y.

518,773. Telephone System. Upton H. Balsley, Philadelphia, Pa.

A two-part weight is attached to the end of the plug cord, the two parts being electrically connected with the two strands of the cord. The weight is adapted to move between two vertical guides, which are respectively connected to the two sides of the telephone circuit, circuit between the telephone line and the cord terminals being completed through the sliding contacts thus formed between the two-part weight and the vertical guides.

518,782. Distribution System for Electric Railways. James E. Goodhand, Baltimore, Md.

518,788. Electrical Instrument Table. Jacob F. Mehren, Chicago, Ill.

518,792. Duplex Arc Lamp. Charles E. Scribner, Chicago, Ill.

The lifting magnets and carbons of the two lamps are placed in series multiple, the fine wire coil of the feeding magnet of each lamp being each in a different shunt around the carbons of both lamps, an extra coil being provided upon the feeding magnet of one lamp and wound to oppose the fine wire coil thereof, the extra coil being included in circuit with the carbons of the other lamp, the lamps being thus caused to burn in succession.

518,793. Lightning Rod and Coupling. John W. Smith, Galesburg, Ill.

518,800. Electric Switch, Ernst Woltmann, Chicago, Ill.

518,885. Tabulating System. Herman Hollerith, Washington, D. C.

518,886. Tabulating System. Herman Hollerith, Washington, D. C.

518,906. Automatic Device for Removing Resistance in Starting Electric Motors and Replacing Same. George H. Whittingham, Baltimore, Md.

518,907. Cleat for Supporting Conducting Wires for Electric Circuits. Horace B. Wyman, Slingerlands, N. Y.

518,913. Commutator Brush. George W. Brown, Deering, Me.

The brush is composed of woven wire cloth folded together and having its inner layers saturated with a graphite compound, the whole being in a flexible condition and adapted to make contact at its end with the commutator.

518,916. Telephone Transmitter. Herbert Cottrell, Newark, N. J.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents which expired during the week ended April 24, 1894:

189,997. Magneto-electric Machines. Charles F. Brush, Cleveland, O.

189,998. Electric Clocks. C. F. Brush, Cleveland, O.

189,999. Electro-magnetic Railroad Signals. H. Brunius, Jonkoping, Sweden.

7,627. Printing Telegraphs. Pierre A. J. Dujardin, Lille, France.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, MAY 12, 1894. No. 19

Electric Lighting of the New York Life Building, Chicago.

Perhaps none of the new lofty office buildings of Chicago has excited more favorable comment for the rapidity of its construction, the really handsome appearance it presents, both inside and out, and for the well appointed and light offices, which were made ready to a great extent for the reception of their occupants about May 1st, than the New York Life building. This block, which is located upon the northeast corner of Monroe and La Salle streets, is 12 stories in height and takes rank among those structures which have made the architecture of Chicago

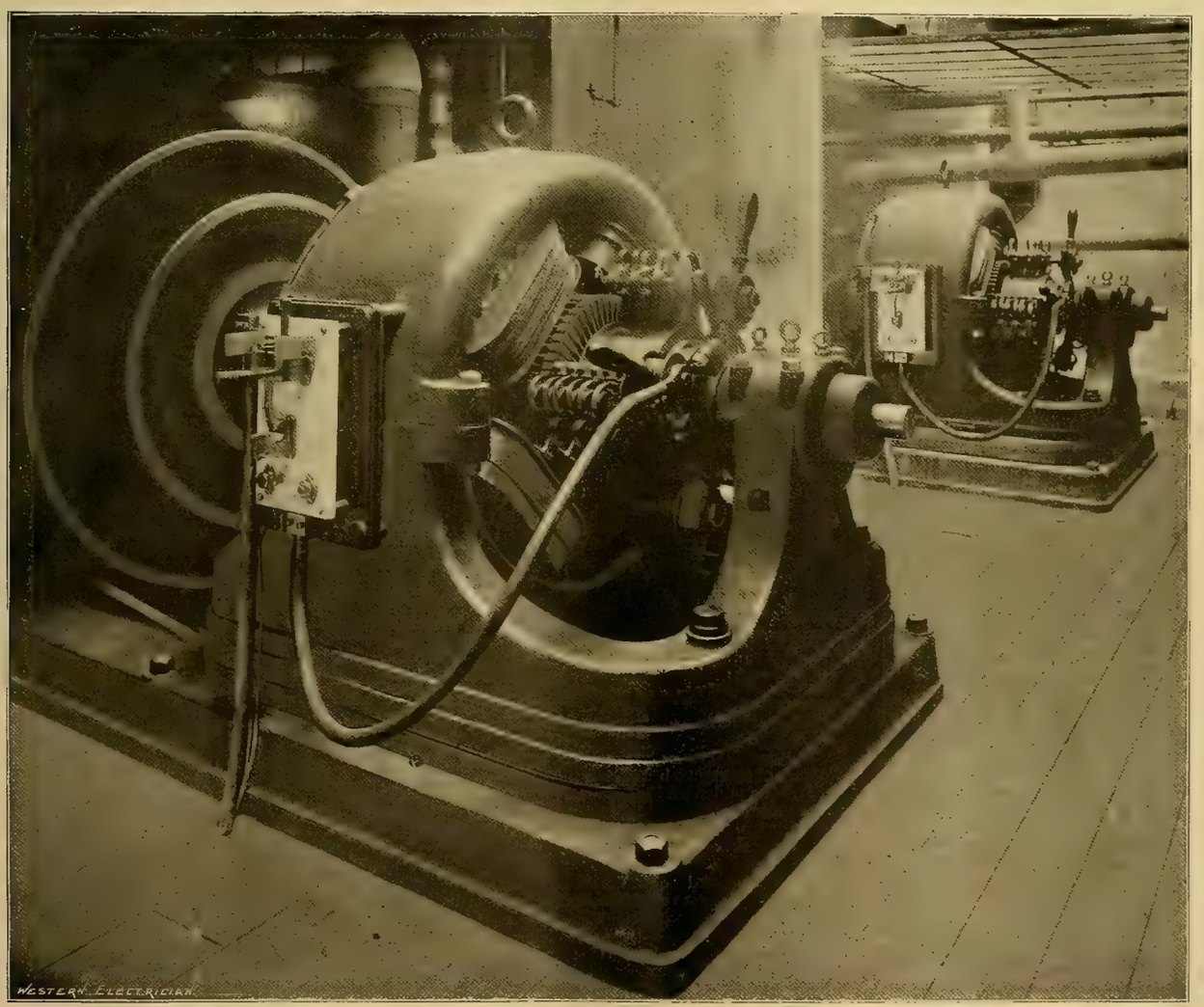


FIG. 1. ELECTRIC LIGHTING OF THE NEW YORK LIFE BUILDING, CHICAGO.

business blocks so conspicuous. Although somewhat hastily erected, great attention has been paid to the details of the appointment of the building. The finish of the interior is done in marble throughout, and every effort has been made to insure absolute safety from fire. The basement is a most interesting portion of the block to engineers, and an inspection reveals the latest ideas in elevator, electric lighting and steam heating machinery. The electrical plant in particular is worthy of more than passing notice, for, as is the case in so many of the modern office buildings, the problem of lack of room presented itself, and it was necessary to calculate very closely to obtain sufficient floor space for the necessary machinery. The dynamo room is about 30 by 45 feet and in it has been installed an amount of machinery which in itself speaks in the highest praise for the designer of the plant. The building is wired upon the two-wire system, the cables being led up a shaft and each floor wired separately. Every precaution which experience and the requirements of the underwriters and a vigorous inspection department could suggest has been embodied in the wiring system and it may be taken as a model of modern electric light wiring. Louis K. Comstock designed this portion of the work.

The generating apparatus consists at present of two Westinghouse 75 kilowatt multipolar dynamos, wound for 125 volts, operated at 300 revolutions, directly connected to two vertical single-acting automatic compound engines of 100 horse power capacity each, with cylinders 12 by 20 by 12 inches. These engines are manufactured by Westinghouse, Church, Kerr & Co., and under actual test are claimed to have a water rating under 90 pounds pressure with four pounds back pressure of 24.04 pounds of water per horse power hour. The combination of these machines and dynamos is known as the kodak outfit. This outfit is provided with a patent flexible coupling between engines and dynamos, which will allow for any misalignment in either of the shafts to the extent of half an inch. Another feature of this combination is the insulation between the steam and electrical parts. In Fig. 1 is presented a view of a portion of the dynamo room, including the two dynamos. The boiler header and main steam pipes to the engine are drained with the Westinghouse steam-loop system. The boiler header is 18 inches in diameter and in common with the other steam pipes is covered with asbestos. The main steam run, supplying the engines—provision having been made for a third dynamo and engine—is 10 inches in diameter. The engines exhaust directly into a receiver placed between them. The heating system of the building is connected to this tank. The dynamos rest upon concrete foundations built up with brick and are insulated from them. The conductors from the dynamo connections are led under the floor in conduits to the switchboard, which is shown in Fig. 2. The connections upon this board are made upon the back, and upon its face are mounted three Weston ammeters, a Weston voltmeter, two three-point dynamo switches, three overthrow line switches, two rheostats and a voltmeter switch. The board is of white marble, and, as seen by the picture, presents a very pleasing appearance. In addition to the lighting provision is made for power purposes in several portions of the building, one example being furnished in the dynamo room, where a one horse power Eddy automatic motor, type C, wound for 110 volts, drives a 24 inch ventilating fan. The motor is shunt wound and is provided with the Cutler and Hammer magnetic automatic rheostat. This device, which is now required by the city inspection department, consists of a magnet upon the contact arm, which, immediately upon the failure of current releases the contact from the point of least resistance, and a spring throws it to the point of most resistance, so that when the current is again furnished the

motor may be started slowly, thus avoiding the danger of a burn-out.

The power of the building is supplied by four horizontal tubular boilers, each boiler being five feet in diameter and sixteen feet long, and each containing 46 four-inch flues. The boilers have a six-inch steam outlet, and are so arranged that any boiler can be run separately or all together. The shell of each boiler is three-eighths inch thick and the heads one-half inch thick. All of the material is of Carnegie, Phipps & Co.'s fire-box steel, stamped 55,000 pounds in tensile strength, and each plate is in conformity with United States laws and regulations pertaining to elongation and reduction of area. Each boiler is composed of two plates, one continuous rolled plate for bottom

FIG. 4. ELECTRIC LIGHTING OF THE NEW YORK LIFE BUILDING, CHICAGO.

half of shell of boiler and the same for the top half of the shell of the boiler. The boilers contain 3,600 square feet of heating surface and 100 square feet of grate surface. They are made to carry 125 pounds of steam, if necessary, and are nominally rated at 125 horse power each. Their construction, as well as the railway used in carrying coal from the bins to the fire-box, is shown in Fig. 3, which is a general view of the boiler room. The boilers are made by John Mohr & Son, Chicago. Another of the power applications is illustrated in Fig. 4, where a 7½ horse power Eddy motor is seen driving a 62-inch Sturtevant blower. This motor is of the same type as the one previously mentioned, is provided with similar controlling apparatus and turns at a speed of 1,975 revolutions a minute. The dynamo room, in addition to the machinery mentioned, contains a Baragwanath combined heater and receiving tank, two double-acting 7½ by 4½ by 10 inch Worthington pumps, a cold water receiver, a hot water tank and the switchboard and machinery of the Johnson heating system.

The Johnson system of heat regulation consists of a series of thermostats placed in the different rooms and halls of the building. A thermostat is connected to the main electric wire. Each binding post has a branch wire to the corresponding binding post on an electro-pneumatic valve which is also placed in the room near a steam diaphragm valve, the thermostat spring, being forced against either binding post, makes a circuit, which is carried to the electro-pneumatic valve and by its magnets throws the

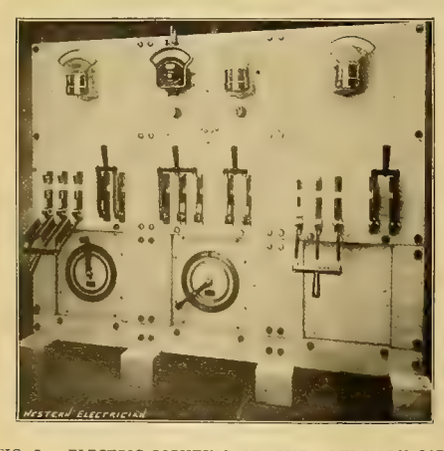


FIG. 2. ELECTRIC LIGHTING OF THE NEW YORK LIFE BUILDING, CHICAGO.

inside workings of the pneumatic valve, so as to either allow the compressed air to pass through the pneumatic valve to the diaphragm top of the steam valve, thus closing it, or by making a cold connection, preventing the compressed air from passing through the pneumatic valve to the radiator valve diaphragm, thus holding the steam valves open until the temperature of the room again rises to where the thermostat indicates that it should shut off the steam. The switchboard of this system is shown in Fig. 5. It is located in the dynamo room. At the base of the board are the storage batteries which furnish the current for the system. A reversing switch is placed upon the board by which the current from the dynamos is switched from one set of batteries to the other. There are also 12 floor switches, a couple of relays and a bell to give notice of a short-circuit in any part of the building. Compressed air is furnished by a duplex air compressor. The system is employed in many of the Chicago office buidings and has given excellent satisfaction. The entire electrical and engine plant was installed by the Chicago office of Westinghouse, Church, Kerr & Co.

Injunction Against the Buckeye Company Refused.

In the Circuit Court of the United States for the Northern District of Ohio, eastern division, Judge Ricks last week handed down a decision in the case of the Edison Electric Light company and the Edison General Electric company against the Buckeye Electric company, refusing an injunction to restrain the manufacture of incandescent lamps. Following is the opinion accompanying this decision:

This case comes again before the court upon a motion for a preliminary injunction. Since the former motion for a dissolution of the injunction allowed in 1893 was passed upon, the plaintiff has filed additional affidavits in support of the pending motion. Though this motion asks for the order without assigning any reason, the affidavits disclose new facts which were not brought before the court on the previous application, and, though the plaintiffs did not desire to confine their application to the new facts thus presented, the court sees no reason why, upon this action, the case should be again considered upon the matters so fully heard, considered and decided in the opinion heretofore filed.

I shall therefore consider only the question as to whether the new facts entitle the plaintiffs to a preliminary injunction. In granting the defendants' motion to dissolve the injunction then in force, the court found that there had been such acts on the part of the plaintiffs in their application to the Patent Office to limit the duration of the Edison patent, and in the proceedings connected therewith, and subsequent thereto, and in their negotiations with the defendant relating to the manufacture of lamps claimed to be covered by the patent, as to stop the plaintiffs from claiming as against these defendants that their patent did not terminate in November, 1893, or that, as against the defendants, they had a right to such an injunction.

The new facts disclosed by the affidavits are that at the time the owner of the patent and the assignee thereof made their application to the Patent Office in October, 1883, asking for a limitation of the life of the patent, and at the time of the proceedings taken under said application, a contract was in force by which the owner of the patent had given the exclusive right to manufacture lamps under the patent to Edison, the patentee, and to certain persons whom the contract stipulated might be associated with him in that undertaking. That contract was made on the 8th day of March, 1881. On the 12th day of January, 1884, Edison and his associates named in the contract of March, 1881, assigned and transferred to the Edison Lamp company, a corporation organized under the laws of New Jersey, all their title and interest in the said contract, and also all their interest in a second contract between the Edison Electric Light company and the Edison Lamp company, made October 11, 1883.

This right to exclusively manufacture lamps, thus vested in Edison and his associates, was in force when the owner of the patent and Edison joined in the Patent Office application of October, 1883. The associates of Edison in that exclusive right, it is claimed, were not advised of what Edison and the owner of the patent did with reference to the said proceedings in the Patent Office, were not bound thereby, and that, so far as their rights in that contract are concerned, they are not now stopped from claiming a preliminary injunction to any acts of the owner of the patent or the patentee.

The case is practically, therefore, the application of the holders of this equitable interest in the contract of March, 1881, for a preliminary injunction against the defendants. It has already been decided that the assignee of the patent and the patentee are not entitled to such relief. Those who now ask for the injunction upon the new facts disclosed must show their right to this remedy and relief by the same rules and upon the same principles governing any other applicant for such an order.

What, then, are the facts disclosed as to the legal relations existing between the parties interested with Edison in this contract of March, 1881, and the owner of the patent and the patentee, and what was the information they had of the proceedings instituted in the Patent Office in October, 1883, by which their interest and rights in their existing contract were affected? The contract of March, 1881, between the assignee and the owner of the patent and Edison is an exceptional instrument. It confers upon Edison very valuable rights, coupled with very liberal conditions, and every provision contains terms showing it was not intended to be assignable. It was a contract showing in every line an intention to confer upon Edison personally the liberal and flexible conditions stated. The persons whom he was authorized to associate with him in the undertaking contemplated in the contract were his associates in his laboratory experiments, and closely interested with him in the success of his patents. It is important to keep in mind these relations in considering how far they are justly bound by Edison's participation in the Patent Office proceedings of October, 1883. It is not now necessary to determine whether in their association under the contract of March, 1881, they were partners or not. We are not informed of the exact nature of their legal relations, further than they are disclosed by the terms of that contract and by their affidavit. They were associated in that enterprise under such relations as makes it difficult to believe that they were for any great length of time ignorant of the Patent Office proceedings of October, 1883, and of Edison's participation therein. It is true that in their affidavits they each deny that Edison was authorized to act for them in joining in that application, and with varying explicitness each denies that he knew of such act of Edison's at the time. I accept these statements as true, but they are not inconsistent with the contention made by defendant that, because of their intimate association in the enterprise, they must have learned of that proceeding soon after it took place, and that they have since ratified the act of their associate in different ways. And for the purposes of this preliminary hearing, when the granting of this application rests so largely in the discretion of the court, reasonable references and conclusions, based upon the facts as imperfectly disclosed in *ex parte* affidavits, are proper to be considered. Having already found that Edison is not entitled to this injunction, have his associates in that contract so clearly shown that they have been ignorant of the successive acts and of the conduct of their patentee, which have estopped him, as not to be precluded from claiming this relief as against the defendant? The burden is upon them to establish such want of knowledge and such conduct on their part as to entitle them to this extraordinary relief. If they considered their interest in the contract of 1881 as valuable from October, 1883, to March, 1893, as they now do, they were bound to protect it by such acts and conduct as not to mislead those dealing with this patent, and with its inventor and owner. With the certificate of correction attached to every copy of the Edison patent issued October,

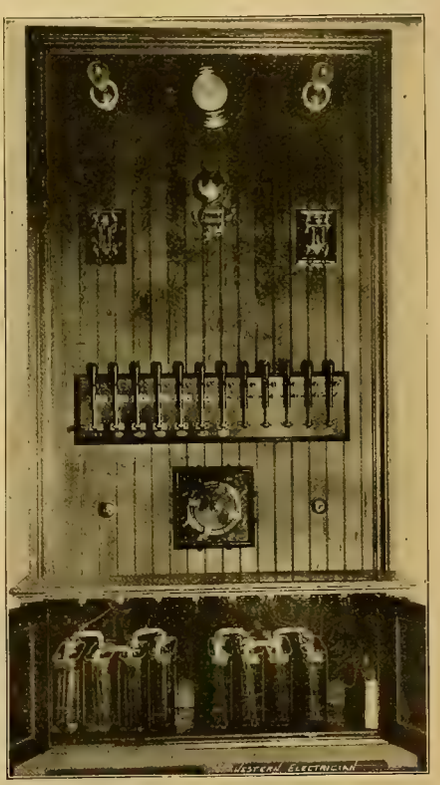


FIG. 5. ELECTRIC LIGHTING OF THE NEW YORK LIFE BUILDING, CHICAGO.

1883, and March, 1893, and with the concern that existed as to the effect of the Patent Office proceedings upon all interested in the patent, it seems highly improbable that during all that period these associates of Edison remained in ignorance of what had been done. If they were so innocent and ignorant during that time, it ought to so affirmatively appear, for it is the fact most important in view of the decision of the court dissolving plaintiffs' injunction allowed upon the original hearing. Having failed to make this full and explicit denial, I am warranted, in view of all the facts, in concluding that these associates of Edison did acquire the knowledge of this Patent Office proceeding during the period named.

Edison and his associates transferred their title and interest in the contract of March, 1881, to the Edison Lamp company in January, 1884. They were the sole stockholders and the only parties interested in the new corporation. It was the same parties associated in the same enterprise under corporate name. They changed their legal relations, and took their new title to ownership charged with all the knowledge and burdened with the same duties as to third persons that rested upon them as "associates" under the contract of March, 1881.

Having knowledge of the part taken by their associate, Edison, in the Patent Office proceeding, they were charged with the knowledge of its legal effect on their rights under the contract of 1881, and they were charged with the duty of protecting them by their subsequent acts and conduct. While Edison estopped himself from claiming an injunction by his acts and conduct between October, 1883, and March, 1893, as found in the decision hereinbefore referred to, it does not follow that his associates were likewise estopped. But in this hearing it ought affirmatively to appear that those parties who claim a prior equity to the defendants were ignorant of, and did not participate in or authorize, the several acts and the line of conduct which it has been held estopped the other plaintiffs from claiming relief against those defendants. This should appear so satisfactory as to justify the court in granting this unusual relief. The burden is not on the defendan

to show that this injunction should not issue, but it is on the plaintiffs, who claim a prior and superior equity not affected by the estoppel heretofore found to preclude their associate plaintiffs to show that it should issue, and this must be shown by the required degree of certainty. I do not think this has been done.

In 1892 the plaintiffs, who now join in this suit, instituted a suit upon this same patent against the Sawyer-Man Electric company. This was at a time when the certificate of correction was still supposed to be in force and was a ratification of that correction so far as the licensees were concerned. They then believed the proceedings for correction had been valid and effective, and accepted and adopted the beneficient results they supposed followed.

But it has been suggested, inasmuch as the complainants cannot appeal from an order refusing an injunction, while the defendent can appeal from an order allowing one, that the court allow a preliminary injunction, but suspended its operation pending appelate proceedings. By such an order, it is urged, the plaintiffs may have partial relief, and no great hardship be imposed upon the defendant. I would be very glad indeed to have such an agreement made so that this case might be speedily reviewed. I fully appreciate the disadvantage under which the plaintiffs stand, because of the peculiar situation of these litigants, but I have no right to impose upon the defendant the burden and expense of prosecuting an appeal from an order allowing an injunction to which I have found the plaintiffs are not entitled. Such an order might properly be made where the parties assent, or there might be such a condition of proof and such peculiar circumstances present themselves in a case as would warrant the court in making such an order as plaintiffs suggest. The discretion exercised by courts in acting upon motions for injunctions is very great, and each case must be decided upon the facts and circumstances presented, and a proper one might arise for such a departure from the ordinary practice, but I do not find this to be such a case.

The motion for a preliminary injunction is therefore refused.

Chicago and St. Louis Electric Railway Project.

The plan of connecting Chicago and St. Louis by a high-speed electric railway presents many features of great interest, and the project demands increased respect at this time because it has survived the severe financial depression of last fall and winter and now appears to have a fairer prospect of consummation than ever before. To be sure, many of the enthusiastic promoters' promises of 1891 and 1892 have fallen to the ground, but the scheme has exhibited a tenacity that compels attention. A considerable sum of money has already been invested; many outsiders have become interested as stockholders; and it seems likely that the road will be built in some form within a few years. The fact that work has actually been begun on the grading for the 25 miles of track from Alpine, Ill., to Chicago, as stated in the WESTERN ELECTRICIAN of last week, is an additional guaranty of business-like intentions, and brings the potentiality of the scheme home to Chicagoans in a very practical way. The modified plan provides that the road "shall be of standard steam construction [as to roadbed and track] in order that it may be available and valuable in case of failure of its electrical features." The capital stock has been accordingly increased from $7,000,000 to $10,000,000, and the company announces, in a new statement, that it will make an active effort to secure freight as well as passenger business. Prof. F. E. Nipher, of the electrical engineering department of the Washington University, St. Louis, is president of the company; Wellington Adams is general manager, and T. C. Hughes chief engineer.

The distance between Chicago and St. Louis in a straight line is 256 miles, and it is proposed to traverse this distance with high-speed electric motor cars for passengers in three hours. A sketch of one of these cars is shown in Fig. 1. It is a long, low car of steel framing, having four pairs of drive-wheels. Each of these cars will have two bogie motor-trucks, one at each end, upon which the car body will be swung in such a way that its center of gravity will lie below the plane of the axles. The car will have an entrance for passengers in the center of one side. A smoking room is provided at one end of the passenger compartment, and at the other end there are two toilet rooms. Immediately behind, and extending over the forward truck, there is a compartment for the motorman; over the rear truck there is a compartment for a limited amount of baggage, mail and express. The top of the car stands only nine feet from the rails. This brings the center of gravity very low and near to the track, which makes the car less liable to jump the track. The front of the car is semi-wedge shaped to minimize the atmospheric resistance, which becomes an important factor at high speeds. The cars will be handsomely finished, and will be illuminated and perhaps heated by electricity. It is expected that the low mounting will contribute materially to the ease of riding. The cars, with their motors, will weigh, when loaded, 60,000 pounds, which will be supported on the eight driving wheels over about forty feet of track-way. All of the weight of passengers and car will thus be available for traction. These cars may be run singly, used for hauling other cars or coupled together.

FIG 1. CHICAGO AND ST. LOUIS ELECTRIC RAILWAY PROJECT.—HIGH SPEED PASSENGER COACH.

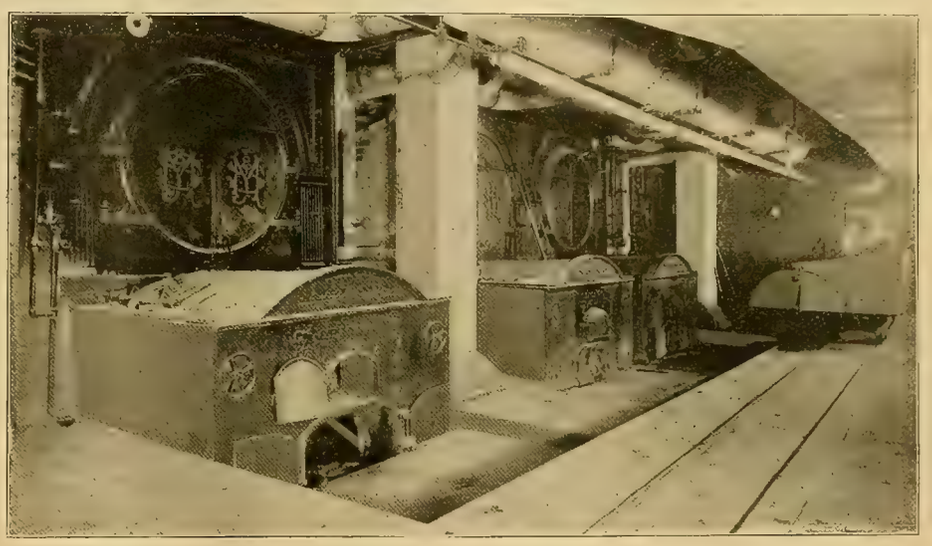


FIG 3. ELECTRIC LIGHTING OF THE NEW YORK LIFE BUILDING, CHICAGO,

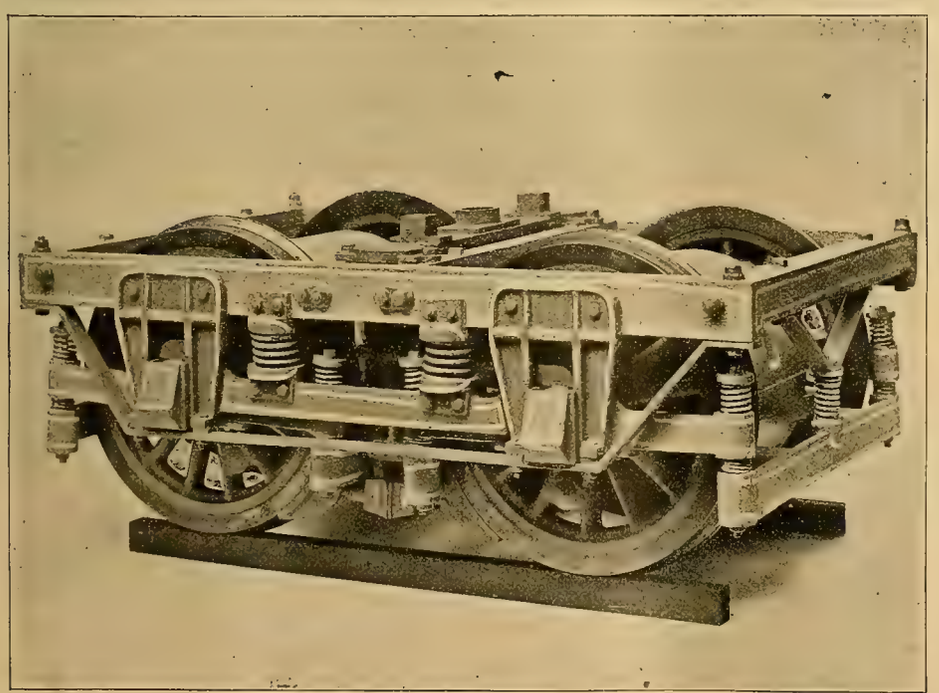


FIG. 2. CHICAGO AND ST. LOUIS ELECTRIC RAILWAY PROJECT.—MOTOR TRUCK FOR HIGH SPEED PASSENGER SERVICE.

A picture of the motor truck for passenger cars is shown in Fig. 2. There will be two directly connected motors on each truck, or four to a car, supplied with current by an overhead trolley contact in the usual way. Much care has been exercised in designing these trucks. The car body is supported through eliptical springs upon a swinging bolster, and from thence upon the axles through nest coil springs and equalizing bars. The motors are mounted concentrically upon the axles through springs, and directly connected with such axles through flexible or link couplings. The motors are held against the torque by separate torque springs, which prevent the jar and shock of starting and stopping. Each individual axle with its motor is entirely free to move independently. It only requires the loosening of four bolts to drop a motor off the truck for repairs. Each truck is provided with regular toggle-lever, locomotive air brakes. The driving wheels are four feet in diameter. The car axles of a Pullman car traveling seventy miles per hour are said to revolve at the same speed that the axles of these motor trucks will revolve at when they are traveling 100 miles per hour; hence it is claimed that the friction will be no greater in the latter case than in the former, other things being equal, but especial care has been exercised in designing the axle-boxes to provide perfect bearings and thorough lubrication.

Fig. 3 shows the design of the motor car for freight. It is proposed to equip an ordinary freight car with four 60 horse power motors, one upon each axle. The motorman is provided a small compartment at one end of the car, as shown, and occupies an elevated position, from which he can readily view the track in front and the train behind. The total weight of this car, loaded, will be 58,000 pounds, and it is computed that two of these freight motor cars, with the adhesive force of 16 driving wheels, will haul a twelve-car freight train at a rate of 19 miles an hour, as there are no grades greater than one per cent. on the line. In considering the transportation of freight by means of electric motors the engineers of the company say: "To make the difference between the steam and the electric system more apparent, it is but necessary to bear in mind that with two such electric motor cars there are sixteen driving wheels, each having a load of 7,250 pounds, or a total weight of 116,000 pounds available for adhesion. Now, if, as is usual, the steam locomotive should have this weight on four driving wheels, the amount on each wheel would be 29,000 pounds; if placed on six wheels the amount on

each wheel would be 17,572 pounds; and if placed on eight wheels, then each wheel would be loaded with 14,500 pounds. Since the latter number of driving wheels is about the limit of good locomotive practice, it is unnecessary to carry the comparison further; hence it is apparent that under any practical conditions the steam locomotive will have practically twice the weight on each of the drive-wheels as the electric motor car, and the steam locomotive can do no more work than the two freight motor cars herein compared with such locomotives. A steam freight locomotive such as we have just considered, with eight drive wheels, can, however, scarcely maintain a speed of 20 miles per hour on a level track, because of the rigid character of its wheel base, whereas the electric motor cars can attain any desired speed, being limited in speed only by their tractive power."

In the matter of track construction it is proposed to do thorough work. The road will be double track and of standard gauge, with 72 pound steel rails. There are to be no grade crossings; all farm roads and other lines of travel will go under or over the level of the road. The overhead construction will consist of the high pressure feed wires for conveying the current from the power houses to the different transformer stations and of trolley wires for conveying the current to the cars. The trolley wire will be held in place by being swung from a longitudinal steel wire provided with short, flexible steel cords every twenty-five feet, as shown in Fig. 4. This will permit of the trolley wire being made practically parallel to the track-way, so that the trolley wheel upon the car may travel in a plane of practically uniform height from the track-way. The suspension wire is fastened through insulators to a cross-arm extending out from center poles, shown in cross-section in Fig. 5, these poles being 100 feet apart. At each pole the line is so fastened as to prevent swinging and vibration, while yet admitting to perfect freedom of vertical movement. Double insulation is provided throughout. The trolley wire will hang about one foot above and one foot to the side of the car.

It is proposed to use the multiphase current, although this plan may be modified later. Four power houses are to be established at intervals of about fifty miles, each at the mouth of a coal mine owned by the company, as nearly the whole right-of-way, over half of which has been secured, runs over the vast deposits of bituminous coal of Illinois. The coal mines are to be operated by electric power and arranged so that the product can be dumped directly into the boiler room from the mine hoist. Coal will also be sold. Multiphase current will be generated and raised to 10 000 volts by transformers and then distributed each way to transformer sub stations, in the manner indicated in Fig. 6. At these sub-stations the current will be reduced first to 2,000 and then to 500 volts and conducted to the trolley wires. The proposed arrangement of the sub-stations is given in the diagram shown in Fig. 7. The trolley wires are divided into sections of five miles each, as shown, and an automatic arrangement is provided by which the passage of a car from a section automatically shuts off the current from that section, thus constituting an effective electric block system. Of course, this plan contemplates the use of multiphase motors, and the company has assurances from Capt. Eugene Griffin and

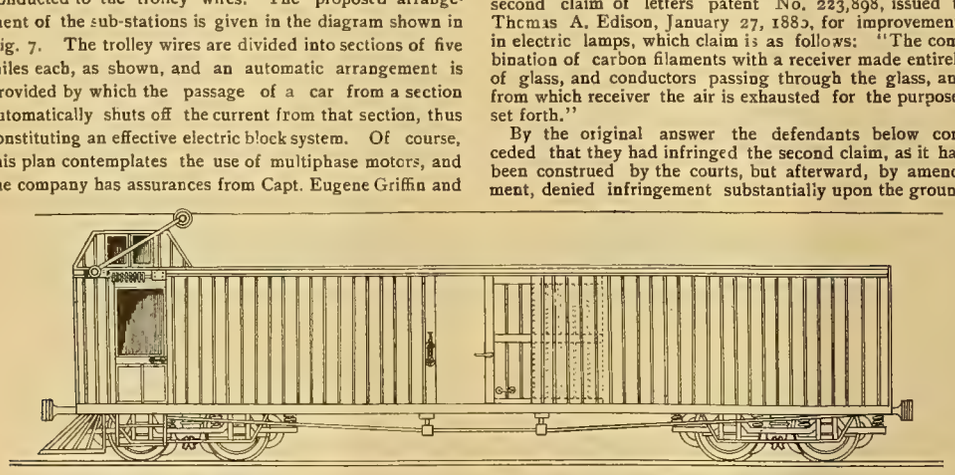


FIG. 3. CHICAGO AND ST. LOUIS ELECTRIC RAILWAY PROJECT.—PROPOSED FREIGHT CAR.

W. H. Knight of the General Electric company, and from Brown, Boveri & Co. of Baden, Switzerland, that motors complying with the prescribed conditions can be furnished. In Fig. 8 is shown one of the future power houses, located at Edinburg, Ill., where the company owns a coal mine.

Important Telegraph Line.

Work is now in progress on the new telegraph line of the Postal Telegraph-cable company which will connect La Junta, Colo., with Mojave, Cal., making a most important link in the company's trans continental system. The line will be 1,300 miles in length, and at Mojave, in Southern California, it will connect with the main Pacific Coast line of the Postal company. Thus, with the existing lines east of La Junta, direct communication between Chicago and San Francisco will be established. The new line is especially noteworthy from the excellence of its construction and from the fact that a circuit will be worked directly from Chicago to San Francisco without relays. The wires are of copper weighing 300 pounds to the mile, so that 390 tons of copper will be consumed for the first two conductors alone. It is said that this line will be the heaviest copper telegraph line in existence. The poles are 25 feet high and seven inches in diameter at the tops. They will be mostly of sawed redwood—a wood that resists decay better than any other. About 100 miles of the line is already finished, and the whole is to be completed by October 1st. Dynamo current will be used both at the terminal and intermediate stations.

Incandescent Lamp Litigation.

Announcement was made in the last issue of the WESTERN ELECTRICIAN that on May 1st Judge Jenkins, in the United States Circuit Court of Appeals for the seventh judicial circuit, filed an opinion in the case of the Electric Manufacturing company and others, appellants, against the Edison Electric Light company and the Edison General Electric Light company. The case was an appeal from the Circuit Court of the United States for the eastern district of Wisconsin, which had granted an injunction restraining the Electric Manufacturing company from manufacturing or selling incandescent lamps that infringed the Edison patent. The injunction was confirmed. Following is the full text of the opinion:

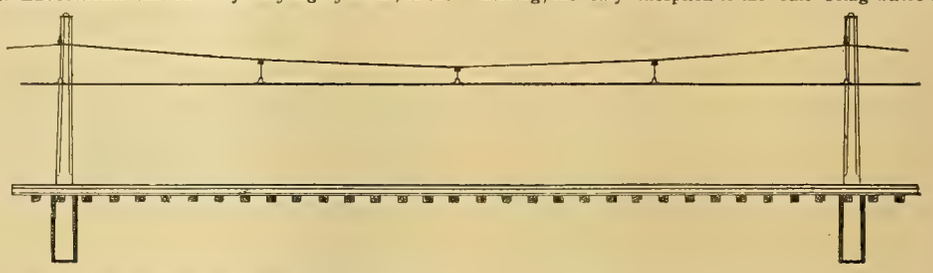


FIG. 4. CHICAGO AND ST. LOUIS ELECTRIC RAILWAY PROJECT.—METHOD OF SUSPENDING TROLLEY WIRE.

FIG. 8. CHICAGO AND ST. LOUIS ELECTRIC RAILWAY PROJECT.—SITE OF POWER HOUSE AT EDINBURG, ILL.

The appellees filed their bill in the court below to restrain the infringement by the appellants here of the second claim of letters patent No. 223,898, issued to Thomas A. Edison, January 27, 1880, for improvements in electric lamps, which claim is as follows: "The combination of carbon filaments with a receiver made entirely of glass, and conductors passing through the glass, and from which receiver the air is exhausted for the purposes set forth."

By the original answer the defendants below conceded that they had infringed the second claim, as it had been construed by the courts, but afterward, by amendment, denied infringement substantially upon the ground that by the proper and narrower construction which they insisted should be given to the claim by reason of the prior state of the art founded upon an alleged prior invention by one Goebel, not considered in the prior litigation, the defendants' lamp should not be construed as infringing upon the patented rights of the appellees. The patent itself was also attacked upon the ground of the alleged prior invention of Goebel. The court below, upon a hearing, granted an injunction *pendente lite*, from which order this appeal is prosecuted. The case below is reported in 57 Fed. R., 616, where the facts are sufficiently stated for the disposition of the case here.

The question presented by this appeal involves the proper rule for the guidance of the court in allowing a preliminary injunction where there has been previous protracted and expensive litigation resulting in the establishment of the validity of the patent, but where the present alleged anticipation of the invention had not been considered.

The patent in question was sustained in Consolidated Electric Light company vs. McKeesport Electric Light company, 40 Fed. R., 21, and in Edison Electric Light company vs. U. S. Electric Lighting company, 47 Fed. R., 454, which latter case was affirmed upon appeal in the Second Circuit, 11 U. S. App., 33, and followed in Sawyer-Man Electric company vs. Edison Electric Light company, 11 U. S. App., 712. In these cases, however, the alleged prior invention of Goebel was not asserted or considered.

The alleged anticipation by Goebel seems first to have been presented in the case of the Edison Electric Light company vs. Beacon Vacuum Pump & Electrical company, 54 Fed. R., 678, in which case Judge Colt, upon motion for preliminary injunction, asserted the rule that where the validity of a patent has been sustained by prior adjudication, and especially after a long, arduous and expensive litigation, the only question open upon motion for a preliminary injunction in a subsequent suit against another defendant, is the question of infringment, the consideration of other defenses being postponed until final hearing; the only exception to the rule being where the new evidence is of such a conclusive character that if it had been introduced in the former case it probably would have led to a different conclusion. And in such case the burden is upon the defendant to establish this, and every reasonable doubt must be resolved against him. This rule was substantially approved by the learned judge whose decision is before us for review. Judge Hallet, in a similar case—Edison Electric Light company vs. Columbia Incandescent Light company, 56 Fed. R., 496—held to a different rule, substantially to the effect that in such case, as in one where there had been no adjudication, the complainant must show a clear right in support of a preliminary writ, and a defense which puts his case in doubt is sufficient to defeat the application.

We have held in Standard Elevator company vs. Crane Elevator company, 9 U. S. App., 6 C. C. A., 100, that in the absence of prior adjudication or public acquiescence, a preliminary injunction should not be granted unless the rights of the patentee be clear, and the infringement be without reasonable doubt. As applied to the case of a patent that had not passed judicial scrutiny, we declared the rule asserted by Judge Hallet. Where, however, the patent has been strenuously contested, and its validity determined by a competent tribunal, we think a strong presumption arises in favor of the patent, which imposes upon the contestant the burden of attack. Of course such prior adjudication does not conclude the question of right, even as to the defenses passed upon, except as between parties and privies. Such a judgment is not within the principle of *res judicata*. It is effective, however, to impress upon the patent such additional presumption of validity that demands of a contestant a *quantum* and force of evidence, beyond that passed upon in the prior adjudication, sufficient to convince the court of the probability that had such further evidence been presented and considered upon the former hearing, a different result would have been reached. In other words, in such case the patentee may rightfully rest upon his patented right, confirmed to him by the solemn adjudication of a competent judicial tribunal. He who attacks that right must overcome the legal presumption of right in the patentee. The strength of that presumption is variant, depending upon the circumstances surrounding the adjudication relied upon to support it. It is stronger when rested upon a final hearing than upon a motion for a preliminary injunction. Its potential force is intensified by the affirmance by an appellate tribunal of the adjudication in favor of the patent. The extent of the burden of overcoming the presumption is therefore measured by the degree of effective force imputed to the presumption. Where an icipitation of invention has been asserted and determined to be unfounded, the presumption would be much stronger against cumulative evidence to prove anticipation by the one whose claim had been repudiated than where anticipation is asserted in behalf of some other supposed inventor whose claim was not in contention in the case adjudicated. And yet, in the latter instance, in addition to the presumption attaching to the patent itself, there would arise a further presumption more or less strong and depending upon the circumstances, that as the issue was the invalidity of the patent because of anticipation, *bona fide* contestants earnestly striving to undermine the patent, would have asserted the defense if known to them and deemed substantial. It may be difficult to formulate a rule that will comprehend all the conditions which could be presented, but we think it safe to say that in general where the validity of a patent has been sustained by prior adjudication upon final hearing, and after *bona fide* and strenuous contest, the matter of its validity upon motion for preliminary injunction is no longer at large; all defense, except that of infringement, being reserved to the final hearing; subject, however, to the single exception that where a new defense is interposed the evidence to support it must be so cogent and persuasive as to impress the court with the conviction that if it had been presented and considered in the former case, it would probably have availed to a contrary conclusion. In the consideration of such new

defense of anticipation, regard should be had to the rule that such a defense is an affirmative one; that the burden of proof is upon him who asserts it; and that the grant of letters patent is *prima facie* evidence that the patentee is the first inventor of the device described therein, and of its novelty. (Coffin vs. Ogden, 18 Wall, 120; Smith vs. Goodyear Dental Vulcanite company, 93 U. S., 486; Lehnbeuter vs. Holthaus, 105 U. S., 94; Cantrell vs. Wallick, 117 U. S., 689; The Barbed Wire patent, 143 U. S., 275.)

The propriety of this rule is enforced by the considera-

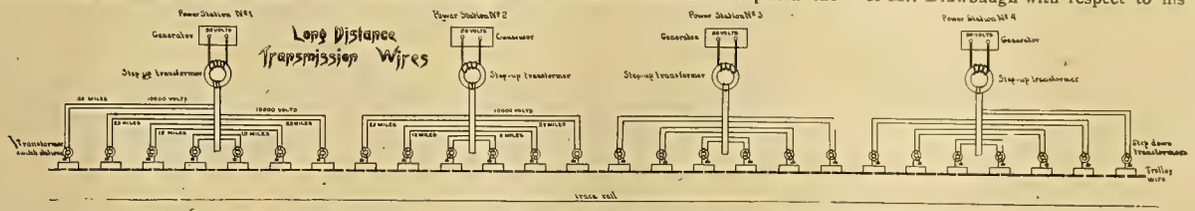


FIG. 6. CHICAGO AND ST. LOUIS ELECTRIC RAILWAY PROJECT.—DIAGRAM OF THE DISTRIBUTION CIRCUITS.

tion that an adjudication in the case of a patent is not only a judgment *inter partes*, but is a judicial construction of a grant by the government and in a broad sense deals with and determines the rights of the public. A patent is *sui generis*. By it the public, through its authorized representative, grants a monopoly for a term of years in consideration of the surrender of the invention to public use upon expiration of the term. When upon judicial contest a competent court has sanctioned the grant and determined the right thereunder, the monopoly thereby granted ought not to be permitted to be invaded except upon a clear showing that the decision invoked in its favor was wrong. It is true that the prior adjudication does not deal with the supposed new defense, and does not affect the merits of that defense upon final hearing; but the fact that it was not presented, especially where the existence of the claim was known to and considered by counsel, is a circumstance to be considered by the court in passing judgment upon the merits upon the hearing for an interlocutory injunction.

We are of opinion that the rule was correctly interpreted by the court below, and properly applied to the case in hand.

We are asked to determine the extent to which this court should go in review of an exercise of discretion by the court below in granting a preliminary injunction. There would seem to be some divergence of opinion in the circuit courts of appeals upon this question. The cases of Jones company vs. Munger Manufacturing company, 2 U. S. App., 188, in the Fifth Circuit; Columbus Watch company vs. Robbins, 6 U. S. App., 275; Blount vs. Societe Anonyme du Filtre Chamberland Systeme Pasteur, 6 U. S. App., 337, in the Sixth Circuit; Consolidated Electric Storage company vs. Accumulator company, 3 U. S. App., 579, in the Third Circuit; American Paper Pail & Box company vs. National Folding Box & Paper company, 1 U. S. App., 283, in the Second Circuit; and Davis Electrical Works vs. Edison Light company, U.S.App., 611, Fed. R., 276, in the First Circuit, are perhaps in antagonism, leading the court of the Sixth Circuit to certify the question to the Supreme Court. That court, however, in Columbus Watch company vs. Robbins, 148 U. S., 266, held that the fact that courts had reached contradictory results did not under the statute warrant the submission of the question for its decision, but might furnish ground for a *certiorari* upon proper application.

We do not deem it needful at this time to enter that field of discussion; because, assuming the right of the appellate court to review to the fullest extent the decision of the court below, we are satisfied with the correctness of the conclusion reached upon the merits with respect to the issuance of the preliminary injunction.

It is not essential that we should enter upon an elaborate or studied investigation of the voluminous mass of evidence presented. It might be improper so to do, since possibly the case upon its merits and after final hearing may come up before us for review. We base our conclusion upon grounds not conclusive of the fact of Mr. Goebel's alleged prior invention, but effective in the consideration of the question whether the case presented is so clear and satisfactory that it overcomes the presumptive force which under the rule adopted must be conceded to the patent. We are content to rest our conclusion upon two grounds which in our judgment sanction the issuance of this injunction.

The great problem in the art of electric lighting to render it practicable for general use was to discover a method of subdivision of the light. This is claimed to have been solved by Mr. Edison and to have been publicly declared in 1879, and the invention secured to him by letters patent issued in 1880. For years before, scientific minds the world over were concentrated upon the investigation of electricity and electric lighting. Innumerable experiments and failures marked the pathway to success. The division of light was asserted by some of the most eminent electricians of the day to be an idle dream and an insoluble problem—an *ignis fatuus*, delusive and unreal. Mr. Edison's invention dispelled the clouds of doubt and demonstrated the accomplished fact. Mr. Goebel claims to have made this discovery a quarter of a century before, in the year 1854, in the city of New York, and to have made these incandescent electric lights for his own pleasure and amusement, and to have used them for lighting his store and to light a wagon upon which was mounted a telescope with which he publicly traversed the streets of that city. As this record is now presented to us, and considering the claim in the light of contemporaneous history, we find it difficult to give credence to the story. During a quarter of a century, from 1854 to 1880, the scientific world was struggling with the problem and could not solve it; and yet, if the claim asserted for Mr. Goebel be well founded, it had already been solved, and he had made public demonstration of it in the commercial metropolis of the Union; the scientific world, however, and the public generally remaining in total ignorance of it. How he could thus hide his light under a bushel passes comprehension. The mind cannot readily yield assent to the assertion of a claim under such circumstances, and when it is supported solely by *ex parte* evidence.

We had occasion in Standard Elevator company vs. Crane Elevator company, *supra*, to make some observations with respect to the weight to be attached to *ex parte* evidence and to the value of a cross-examination. Upon further reflection upon the subject, induced by the submission to us of this case, we deem it proper to re assert and to emphasize what was there said. Certainly we cannot go to the extent of saying that *ex parte* evidence can be relied upon to establish the improbable. It may be that upon final hearing Mr. Goebel's claim may be sustained, notwithstanding the improbabilities attaching to and surrounding it. It is sufficient to say here that we cannot be satisfied as to the fact except upon clear and convincing evidence tested by the ordeal of an intelligent cross-examination.

The further circumstance to which we refer, and which impels us to sustain the order of the court below, is that Mr. Goebel, having accomplished that for which the world was waiting in eager expectancy, that for which scientists were striving and experimenting for a quarter of a century after its discovery, that which was not only of incalculable value to the world, but of unlimited profit to the inventor, never applied for a patent for his alleged invention. That he did not was not owing to any philanthropic motive. He seems to have been a man of much mechanical ingenuity. He understood well the protection which the law yields to the deserving inventor. In regard to small matters he sought that protection. In 1885 he applied for a patent on a sewing machine hammer, and in 1881 for certain other devices; among others for a coil connected with his exhibit lamp. There was, however, no attempt to secure the protection of the Bell telephone, his failure to apply for letters patent therefor, and his obtaining letters patent upon other and less important matters, the court observes that "It becomes important to consider the conduct of Drawbaugh with reference to his alleged invention during these twenty years of eventful history in relation to the discovery and use of telephones. * * * No man of his intelligence, with or without the enthusiasm upon the subject which it is said he possessed, could have remained silent under such circumstances. * * * He was silent so far as the general public were concerned, when if he had really done what those witnesses now think he did, he most certainly would have spoken. There is hardly a single act of his connected with the present claim, from the time he heard before going to Philadelphia that somebody else had invented a telephone which was on exhibition at the Centennial, that was not entirely inconsistent with the idea even then of a complete discovery or invention by himself which could be put to any practical use."

In the barbed wire patent, 143, U. S. 275,-289, the court observe "If Morley regarded this fence of any value, he would have applied for a patent upon it, since he had in fact obtained a patent for his traveling pen, which appears to have been a comparatively worthless contrivance."

Without assuming to say that the story of this invention is untrue, and without designing to suggest what result should be reached upon final hearing, we are compelled to say that the story is surrounded by such an atmosphere of improbability that until it shall have been thoroughly sifted and sustained upon final hearing, the claim ought not to be permitted to invade the monopoly accorded to another for the same invention, whose claim has passed safely the ordeal of judicial scrutiny. We think therefore the court below well held that the patent of Mr. Edison should be protected from invasion *pendente lite*.

The order appealed from will be affirmed.

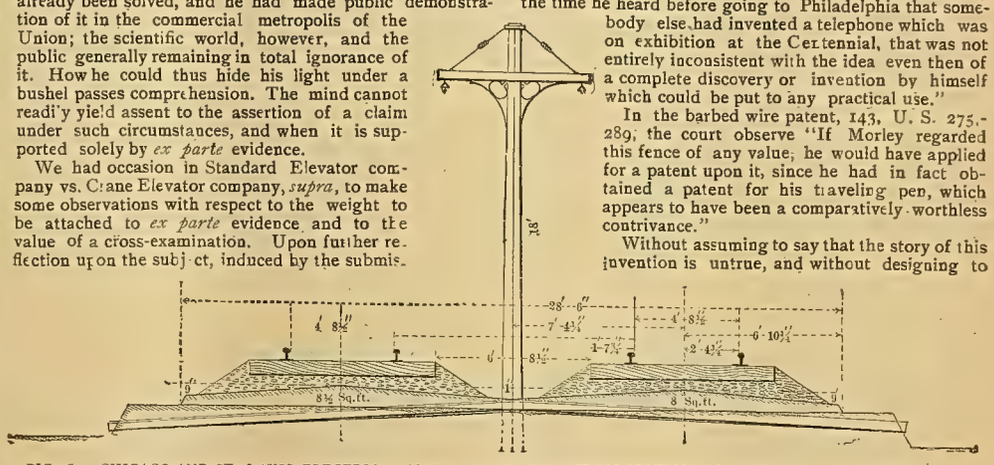


FIG. 5. CHICAGO AND ST. LOUIS ELECTRIC RAILWAY PROJECT — CROSS-SECTION OF TRACK AND OVERHEAD CONSTRUCTION.

Safety Cut-out Patent Litigation.

Argument has been closed before Judge Dallas in the United States Circuit Court at Philadelphia in important patent litigation bearing upon safety cut-outs for incandescent lamps. The plaintiff, Marshall S. Shapleigh, claims that the Chester Electric Light & Power company, the defendant, is using cut-outs similiar to his invention, the devices being manufactured by the Emerson Electric Manufacturing company of St. Louis, Mo., and he asks for a permanent injunction to restrain the alleged infringement. The defendant company contends that no infringement has been made and asserts that there was no invention by the complainant, as claimed. Decision was reserved

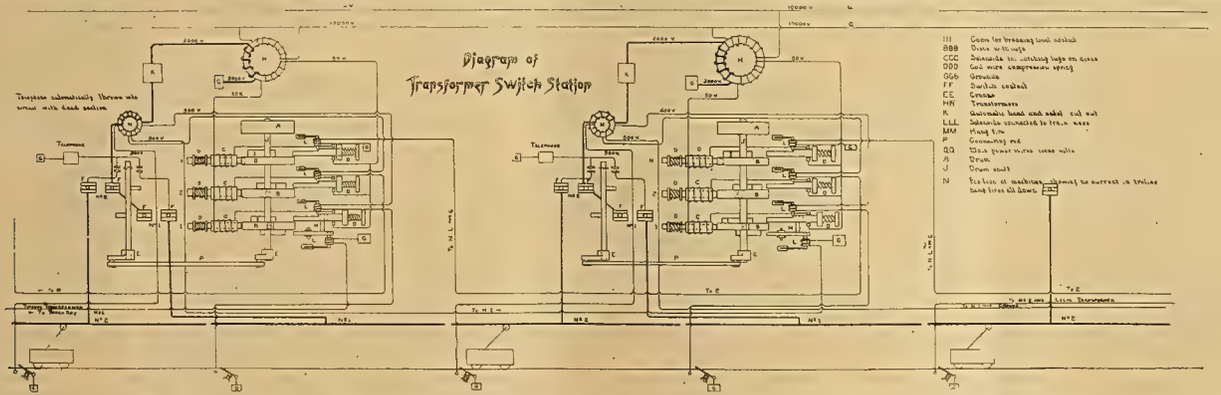


FIG. 7. CHICAGO AND ST. LOUIS ELECTRIC RAILWAY PROJECT.—SUB STATION AND BLOCK SYSTEM CONNECTIONS.

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THAT the daily newspaper press of Chicago does not represent the enlightened public sentiment of the city in indiscriminate opposition to the overhead trolley system of electric traction, is shown by a letter from a prominent West Side property owner, A. E. Havens, recently published in the *Tribune*. Over his own signature Mr. Havens says: "I own property on Ogden avenue and West Madison street, in the Twelfth ward, and am heartily in favor of the trolley, and furthermore, if necessary, or there were any occasion for it, I would not hesitate to guarantee that I could obtain in one week 1,000 reputable business men and property owners in the Twelfth ward who would sign in favor of it. The trolley has proved satisfactory wherever used, and we want it. * * * The people need faster street car service now and the trolley is the most practical thing known at present for cross-town and branch lines. In fact, I would rather see it on Madison street to-day than the cable."

Mr. Havens is correct. The people should have the trolley system for cross-town and auxiliary lines of street cars, not because of any prejudiced or partisan feeling, but because it is vastly superior to the horse cars in comfort, speed and cleanliness. In all but the most congested down-town avenues of traffic it is unquestionably the best method of rapid transit for cities that experience can offer. It has a record of marvelous success, and no city where it has been introduced would now dispense with it. The only objection to be seriously considered is the charge that the appearance of the streets is marred by the poles and wires. This difficulty can be greatly minimized by careful construction and cannot be said to counterbalance, in outlying streets, the acknowledged advantages of the system. The truth is that in Chicago the question of superseding horse cars by electric lines with overhead construction has been so weighted down by other complications—prejudice against the companies proposing the change, charges of bribery among the aldermen, difficulties in securing an adequate remuneration for the franchise, objections by the mayor and the clamor of an ill-informed press—that unthinking people are in danger of forgetting the obvious superiority of the trolley system, in itself, to horse car transportation. This superiority cannot be denied by any fair minded person who has intelligently investigated the subject. The overhead trolley should be given its due, and the people should not deprive themselves of its benefits on account of prejudice against those who now chance to be associated with it in the popular mind.

AT the Philadelphia meeting of the American Institute of Electrical Engineers the question of changing the rules under which future elections will be held will be considered. This is a subject of great importance to all who have the interest of the organization at heart. Several modifications of the present system have been suggested. One of them is that the plan of selecting nominees be changed, the power now exercised by the Council abridged and the will of the majority expressed in the selection of members for the offices to be filled. At the present time, it is understood, the Council exercises a sort of revising power in the matter of preparing a ticket. If the members do not select the candidates desired by the council, a majority of votes will not avail so far as the official ticket is concerned. It is asserted that one of the present officers, whose name appears on the council ticket this year, fell far short of a majority of the votes when the members expressed their preferences for nominations. Unless this assumption of power is checked and a rebuke administered, the Council may take to itself the liberty of reviewing the election returns.

It has been proposed that those names receiving the highest number of votes for each office on the proposal list shall constitute a "members' ticket," which shall be printed and sent to each member together with the regular Council ticket, where in any case the Council sees fit to substitute another name for any of those receiving majority votes on the proposal list, and that the two tickets be printed side by side on a divisible ballot and mailed to each member. It should be further provided that in case of a number of names in excess of the number of officers to be elected to a given position, receiving the same number of votes, all of such names receiving the maximum number of votes shall be placed alphabetically upon the 'members' ticket," with the information that but .... (number) of the names so presented can be voted for.

Some action should be taken limiting the power of the Council or at least specifying more fully the duties of that body. Under the form of organization adopted by the Institute it is probably necessary to have some such governing body, but it is not necessary that this committee or board of managers should assume arbitrary powers and thwart the will of the members. Such action should not be tolerated in any body of intelligent men, and no self-respecting organization should stultify itself by approving some of the measures which the Institute has had referred to it by the Council.

The matter of "branch" meetings may come up, too. The Chicago auxiliary wants the "Institute" to pay the expenses of the meetings of the western members. When the subject of holding these meetings was broached a year ago it was announced by some of the gentlemen who assumed to represent the sentiment of western members that the expense of these meetings would be met by the local members cheerfully, so eager were they, it then appeared, to contribute to the honor and glory of the New York clique. It was pointed out at the time that there was no justice in the arrangement by which western members, paying annual dues, were obliged to pay the expenses of the local meetings too. It appears as if the Institute should at least make some provision for fulfilling its promise to have the meetings in Chicago held "simultaneously" with those in New York, if the local members are to bear the double expense. It would be well for the eastern members to realize that there is wide spread dissatisfaction in this part of the country with the manner in which the affairs of the Institute have been conducted, and that unless there is shown a disposition to consult the wishes of the western members the organization cannot hope to retain even its present limited membership in this section, much less to increase it.

Two incandescent lamp decisions are presented elsewhere in this issue. One of these is by Judge Jenkins, the other by Judge Ricks. The first is considered a victory for the General Electric company; the other is something in the nature of a surprise to that corporation as the opinion clearly and conclusively sustains the decision refusing an injunction against the Buckeye company. So far as the general lighting business is concerned, Judge Jenkins' decision will attract the greater share of attention. In this opinion the "Goebel defense" is considered, and Judge Seaman's decision is affirmed. It will be remembered that, when the Oconto lamp case was heard at Milwaukee, a most complete presentation of Goebel's claims was made, and Judge Hallett's decision at St. Louis was cited as a precedent, but Judge Seaman did not consider the defense sufficient to warrant him in refusing an injunction, especially in view of the fact that Judge Colt had granted a restraining order against the Beacon company which had first presented the Goebel story. Judge Jenkins approves the opinion expressed by Judges Seaman and Colt, that where the validity of a patent had been sustained by prior adjudication, and especially after a long, arduous and expensive litigation, the only question open upon motion for a preliminary injunction in a subsequent suit against another defendant was the question of infringement, the consideration of other defenses being postponed until final hearing; the only exception to the rule being where the new evidence was of such a conclusive character that if it had been introduced in the former case it probably would have led to a different conclusion. The burden is upon the defendant to establish this, and every reasonable doubt must be resolved against him. This rule was substantially approved by Judge Seaman, but Judge Hallett, in the Columbia incandescent lamp case, held to a different rule, substantially to the effect that as in a case where there had been no adjudication, the complainant must show a clear right in support of a preliminary writ, and a defense which puts his case in doubt is sufficient to defeat the application.

Judge Jenkins insists that when a patent has been strenuously contested, and its validity determined by a competent tribunal, a strong presumption arises in favor of the patent which imposes upon the contestant the burden of attack. Many cases are cited in support of the position taken by Judges Colt and Seaman.

Concerning the testimony itself Judge Jenkins says: "Mr. Goebel claims to have made this discovery a quarter of a century before, in the year 1854, in the city of New York, and to have made these incandescent electric lights for his own pleasure and amusement, and to have used them for lighting his store and to light a wagon upon which was mounted a telescope with which he publicly traversed the streets of that city. As this record is now presented to us, and considering the claim in the light of contemporaneous history, we find it difficult to give credence to the story. During a quarter of a century, from 1854 to 1880, the scientific world was struggling with the problem and could not solve it; and yet, if the claim asserted for Mr. Goebel be well founded, it had already been solved, and he had made public demonstration of it in the commercial metropolis of the Union; the scientific world, however, and the public generally remaining in total ignorance of it. How he could thus hide his light under a bushel passes comprehension. The mind cannot readily yield assent to the assertion of a claim under such circumstances, and when it is supported solely by *ex parte* evidence." When final hearing is had Mr. Goebel's claim may be sustained, but for the court "it is sufficient that it cannot be satisfied as to the fact except upon clear and convincing evidence tested by the ordeal of an intelligent cross-examination."

Another feature that casts discredit upon the story in the eyes of the judge is the claim that Goebel, "having accomplished that for which the world was waiting in eager expectancy, that for which scientists were striving and experimenting for a quarter of a century after its discovery, that which was not only of incalculable value to the world, but of unlimited profit to the inventor, never applied for a patent for his alleged invention." This was not due to any philanthropic motive. He seems to have been a man of much mechanical ingenuity. He understood well the protection which the law yields to the deserving inventor. In 1885 he applied for a patent on a sewing machine hammer, and in 1881 for certain other devices; among others for a coil connected with his exhibit lamp. There was, however, no attempt to secure protection for his alleged invention of an incandescent lamp which would have made him independent from the start.

The opinion is carefully prepared, and shows that the court fully appreciated the importance of the case under consideration, and gave it the closest attention.

Apparatus for Neutralizing the Effects of Self-Induction in Alternating Current Circuits.

In the accompanying diagram is illustrated an alternating current system to which has been applied several improvements in the apparatus for neutralizing the effects of self-induction in alternating current circuits made by John F. Kelley and Cummings C. Chesney. Any circuit in which, by reason of self-induction, the current is caused to lag behind the impressed electromotive force is assumed in the drawing, *BB* being a portion of such a circuit from the alternator, *A*, the circuit containing an electro-magnet, *C*, such as the field magnets of an alternating current motor. In parallel to this circuit is a circuit *D*, including the primary, *P*, of a transformer. The secondary, *S*, of this transformer includes in its circuit a condenser, *E*. When these elements are so proportioned that the current in the primary circuit of the transformer is given a negative lag of nearly 90°, and the transformer is of such dimensions that this current is about equal to the lagging component of the main or working circuit, they constitute the combination which forms the subject of the application as here presented. If a condenser be placed in parallel to an electro-magnet supplied by alternating currents and made of proper capacity, it will neutralize the effects of self-induction in the magnet circuit for a given frequency and reduce the current supplied by the generator to the energy limit, such current otherwise being generally in excess of that corresponding to the actual energy supplied.

One of the main difficulties experienced in the use of condensers for this purpose is that the cost of the condenser required for systems of low electromotive force becomes so great that for very low electromotive forces the ordinary condenser becomes impracticable. It has been found, however, that if a condenser of proper capacity be inserted in the secondary of a transformer, the combined transformer and condenser acquire the properties of a condenser with respect to their effect upon the primary circuit. In illustration of this and considering the transformer and condenser described, let A equal the apparent coefficient of self-induction of the primary circuit, T the true coefficient of self-induction of the primary circuit, S the coefficient of self-induction of the secondary circuit, M the coefficient of mutual induction, R the resistance of the secondary circuit, C the capacity of the secondary circuit, m (2 multiplied by 3.1416 multiplied by the number of complete revolutions per unit time) the angular velocity of the current, for it is well known that

$$A = T - \left(S - \frac{1}{m^2 C}\right) \frac{M^2 m^2}{R^2 + \left(mS - \frac{1}{mC}\right)^2}$$

In a properly constructed transformer the coefficient of mutual induction is equal to the square root of the product of the coefficients of the self induction of the primary and secondary circuits

$$(M = \sqrt{T S}),$$

while the resistance of the secondary is very small as compared with the product of the angular velocity and the self-induction of the secondary (m S), hence it is always possible to give such a value to C, the capacity of the condenser in the secondaries, that

$$T < \left(S - \frac{1}{n^2 C}\right) \frac{M^2 n^2}{R^2 + \left(mS - \frac{1}{mC}\right)^2}$$

in which case A, the apparent coefficient of self-induction of the primary, will have a negative value. But a negative value for self-induction is the equivalent to a capacity effect in the circuit. In accordance with this law, in this case, the condenser in the secondary circuit is made of such capacity that it will leave the lag of the current in that circuit behind its electromotive force very great, at the same time increasing the current so that its magnetizing power is greater than that of the primary. Under such conditions the counter electromotive force developed in the primary circuit by the transformer is very nearly in opposition to that which the primary coil alone develops, and, in consequence, the primary current acquires a negative lag. Such a combination, therefore, acts in a similar manner to a condenser, and as it is possible to establish any ratio between the electromotive forces in the primary and secondary circuits, it is also possible, while maintaining a low electromotive force in the main circuit, to apply a high electromotive to the condenser and so to build it cheaply. The current flowing in the primary is given by the equation

$$Cu = \frac{E^2}{\sqrt{Ra^2 + m^2 A^2}}$$

in which Cu is the current, Ra the apparent resistance of the primary and E the impressed electromotive force, the other factors m and a being the same as before. The value of Ra is in turn given by the equation

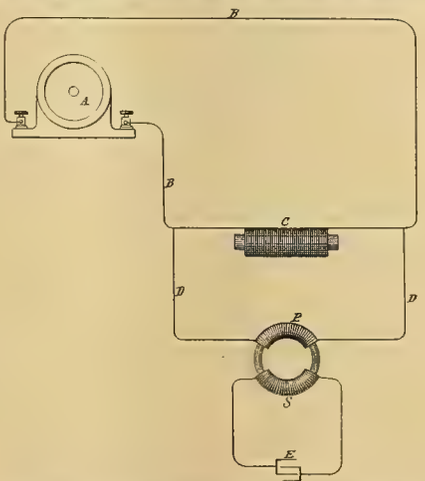
$$Ra = Rp + R \frac{m^2 M^2}{R^2 + \left(mS - \frac{1}{mC}\right)^2}$$

Rp being the true resistance of the primary and the other expressions the same as before.

Evolution of the Electric Incandescent Lamp.

Everything that pertains to the incandescent lamp, its history and development, is of interest at this time, especially such contributions as have a bearing upon the litigation over the validity of the patents held by the several claimants to the honor of the invention. The latest publication in this line is Franklin Leonard Pope's book on the "Evolution of the Electric Incandescent Lamp." This work is a second edition of the book published by the same author in 1889, revised and brought down to date. It comprises a series of articles reviewing the claims of the numerous workers in this department. The author has not materially changed his position on the relative merits of the contributions of the men engaged in the development of a commercial lamp, and the recent decisions of the United States Circuit Courts, it is evident, have not convinced him of the justice of Edison's claim. In the preface to the present work the author refers to this litigation, particularly the case of the Consolidated Electric Light company against the McKeesport Light company before Justice Bradley, which is now before the Supreme Court for review. He says:

The conclusion seems inevitable that in case it is held by the Supreme Court that Sawyer and Man, in their original application for patent protection, adequately described and claimed that which was a necessary result of the process of preparing incandescent carbons, which they appear to have been the first to discover, their invention must in future be recognized in the history of the art as the foundation and corner-stone of the modern industry of electric incandescent lighting.



APPARATUS FOR NEUTRALIZING THE EFFECTS OF SELF-INDUCTION IN ALTERNATING CURRENT CIRCUITS.

The author does not agree with Justice Wallace, whose decision was affirmed by the Circuit Court of Appeals, in the case of the Edison Electric Light company against the United States Electric Lighting company. He claims that the one essential element which differentiates the successful modern incandescent lamp from its unsuccessful predecessors is the arch-shaped illuminant of cellular organic material. This element, he insists, is essential, while the other characteristics which Edison claims may be eliminated from the lamp without affecting its commercial utility. The invention of Sawyer and Man, he continues, consisted in "first forming the material and then carbonizing it," and the filamentary carbon illuminant became a technical possibility only as a result of this process.

An important feature of this work is the "Chronological History of Modern Incandescent Lighting" and the record of the patent litigation in which Edison and Sawyer and Man were the principal figures. Probably one of the most interesting features of the work to those not particularly interested in the study of the scientific problems involved is the collection of newspaper interviews and descriptions of Edison's work, and abstracts from patent applications on file at Washington. These furnish abundant proof that for a long time Edison was groping blindly in the dark, if the statements of his friends and admirers are to be accepted or his own claims literally construed.

Georgetown, O., intends to have an electric lighting plant.

Overhead Wires in Hyde Park, Chicago.

Mayor Hopkins of Chicago is opposed to the erection of any more pole lines in the outlying Hyde Park district of Chicago. He says that the number must be reduced or the wires must go underground. The companies interested are the Pullman Street Railroad company, South Chicago City Railroad company, Grand Crossing and Windsor Park Street Railroad company, Postal Telegraph company, Chicago City Railway company, Calumet Electric Street Railroad company, Chicago Telephone company, Chicago Edison company, Western Union Telegraph company, Hyde Park Thomson-Houston Electric Light company, Hyde Park Electric Light company, Calumet Electric company, Allen Electric Light company and Englewood Electric Light company. A conference of representatives of these companies was held recently to reach an amicable agreement to comply with the mayor's requirements. It is likely the first company to place poles in any one street will retain its property, and that all other companies in the same street will rent of the first.

American Institute of Electrical Engineers.

Arrangements for the annual meeting of the American Institute of Electrical Engineers at Philadelphia are about completed. The following named gentlemen compose the local committee: Elmer G. Willyoung, chairman; C. O. C. Billberg, Alfred E. Braddell, Charles A. Bragg, S. G. Flagg, Jr., Carl Hering, Prof. E. J. Houston, Rudolph M. Hunter, Lieut. E. B. Ives, A. L. Johnston, A. E. Kennelly, E. R. Keller, Minford Levis, Prof. W. D. Marks, A. J. Martin, L. Knowles Perot, Clayton W. Pike, C. J. Reed, T. Carpenter Smith, William A. Stadelman, F. Uhlenhaut, Jr., Peter Wright.

Three sub-committees, on entertainment, hotels and finance, have been appointed, the chairmen of which are C. A. Bragg, C. W. Pike and T. Carpenter Smith.

Headquarters will be established at the Hotel Metropole, corner Broad and Locust streets. This hotel has been running about six months. It is fire-proof and is superbly furnished. It is run on the European plan; $1.50 per day and upwards. Its location is convenient—five squares from the Engineers' club, where the sessions will be held. For those wishing American plan the Hotel Hanover, Twelfth and Arch streets, is offered. This is also a new hotel, and is under the same management as the Hotel Metropole. It is about the same distance from the Engineers' club. Both hotels are within six or eight squares of the postoffice and heart of the city.

The programme is, in general, about as follows:

Tuesday, May 17. Open at 10:30 A. M. at Engineers' club. Welcome by Mayor Stuart of Philadelphia; election, etc. Tuesday afternoon. Papers and Discussion at Engineers' club. Tuesday evening. Annual banquet at Hotel Metropole; theater party for ladies.

Wednesday A. M. Papers—Engineers' club. Wednesday afternoon. Papers—Franklin Institute (this session will include experimentally illustrated papers of Dr. Pupin, Prof. Crocker and A. J. Wurts); tally-ho ride for ladies. Wednesday evening. Reception by the engineers of Philadelphia.

Thursday A. M. Papers—Engineers' club—Adjourn to take boat to Cramp's shipyards, and boat ride down the river for a shad dinner.

Special efforts are being made for the entertainment of ladies who may come.

The Franklin Institute, Schuylkill Navy and Engineers' club have tendered the Institute the use and freedom of the houses, etc., while the Institute is in session.

Electric Railway Litigation.

On May 3d Judge Townsend of the United States Circuit Court at New Haven, Conn., handed down a decision in the case of the Electrie Railway company of the United States against the Jamaica & Brooklyn Railroad company in favor of the defendant. The decision is on a final hearing on a bill in equity, alleging infringement of letters patent granted to Stephen D. Field, July 16, 1889, for improvements on electric railways and assigned to the plaintiff. Judge Townsend, in his opinion, says that the complaint admits that every element in the invention existed at the time the combination was made. Furthermore, he said that there was a question in the Patent Office in 1879 whether patents could be granted to Field because of a prior patent known as the Clark, which embodied the same principle. Patents issued by the French republic prior to Field's invention were for practically the same device. It appears that Field and Edison had applications in the Patent Office at the same time for an electric railway system and they decided to combine their interests. The decision continues:

The Edison eventually separated from the Field interest, the latter being unsuccessful in contesting the Patent Office, and the dissolution was agreed upon by both parties. Even the parties who represented the Edison interests were

actuated in this proceeding by singular motives. They were endeavoring to get rid of a bad bargain, but this does not effect their standing in this case, provided they committed no wrongful act.

By abandonment of the proceedings and the execution of the agreement, the Feld interest looked to protect its rights by absolution of existing corporate relations and the judge holds that it cannot go behind this agreement or extend its operations not embraced therein by reason of prior relations. In view of these considerations, the defendant is not estopped to deny the validity of the first claim of the patent in the suit and the judge orders a decree to be entered dismissing the bill. The decision is a victory for the General Electric company, which defended the action.

Johnson-Lundell Electric Railway System.

Few inventions are more loudly called for by the necessities of the hour than a practical electric railway system adapted for use on metropolitan streets. E. H. Johnson and Robert Lundell have worked out a solution of the problem which is attracting much attention and which is illustrated by the accompanying pictures.

FIG. 2. JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

The track runs around a whole city block in New York with steep grades and with difficult curves of necessarily short radius. The power house is at the foot of the hill and at the center of that section of the track or circuit. The generating plant, as shown in Fig. 1, comprises a vertical engine driving directly a pair of Lundell dynamos, the unit being such that it could be enlarged on exactly the same proportions up to any size for any road. By means of the interior conduit telescopic iron tube, current is carried to the track at the proper points of feeding and is distributed without any loss due to leakage or conduction, owing to the high insulation of the ducts. The track itself is of ordinary construction as to the rails. Between the rails it is asphalted or paved, and paralleling the rails lies a conducting bar or strip of metal embedded in the asphalt. This bar is level with the surface and is divided up into sections with insulating blocks of stone or other material between them. Just outside the single track or midway between the double tracks are plain boxes with iron covers flush with the street surface. In these boxes are substantial electro-magnetic devices which deliver current to each section as the car comes along and then lie quiet until the succeeding car rolls up. These switch-

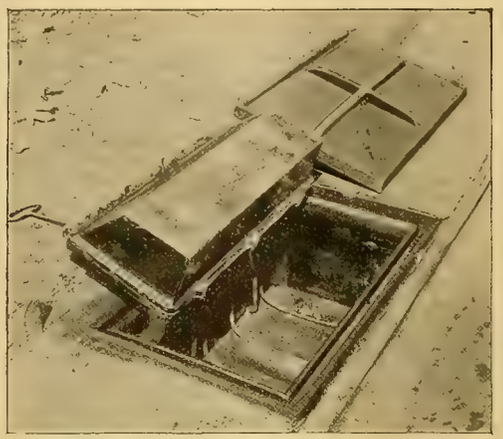


FIG. 3. JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

boxes are water-tight, and each box governs its particular section of the track. In Figs. 2 and 3 are shown an outside switch-box with the cover removed and the box in position for inspection.

The car has but one motor, which is central under the car and drives on each axle by means of bevel gear and with sprocket wheels and link chain in flexible connection with them. Its suspension is flexible, the bevels are boxed, the sprocket wheels and links mesh noiselessly, and by intervention of a bipartite screw coil in close relation to the armature shaft, the motor, though capable of instantaneous arrest or sudden starting, never moves off or stops with a jerk. The spring coils act as a buffer between it and any danger. The motor is, moreover, iron cased and protected against dirt, stones, moisture, etc. Underneath the car is a steel brush which gathers up the current and passes it up into the motor, the return being as usual through the rails, which are obviously harmless, as the conducting strip between them is only alive when a car is directly over it. Under the seats are frames holding a very simple, elementary form of lead storage battery, enough to furnish the voltage at which the motor runs—300 volts—and though with very few plates in each cell giving considerable capacity. The batteries are always in place—they need no change, practically no attention, but at a moment's notice they furnish current and can carry the car through many emergencies.

One of the chief merits of the system is control of the car. The motor employed is of such a construction that the direction of its rotation may be changed instantly without, the inventors claim, any injurious results. A low rate of depreciation and an independence of weather conditions are points which are advanced in favor of this system, to which is added a moderate cost of operation. They constitute an argument which will insure a careful investigation of its details, and from the experiments which have been made it would seem that the Johnson-Lundell system has overcome many of the difficulties which have so far proven insurmountable to street railway inventors.

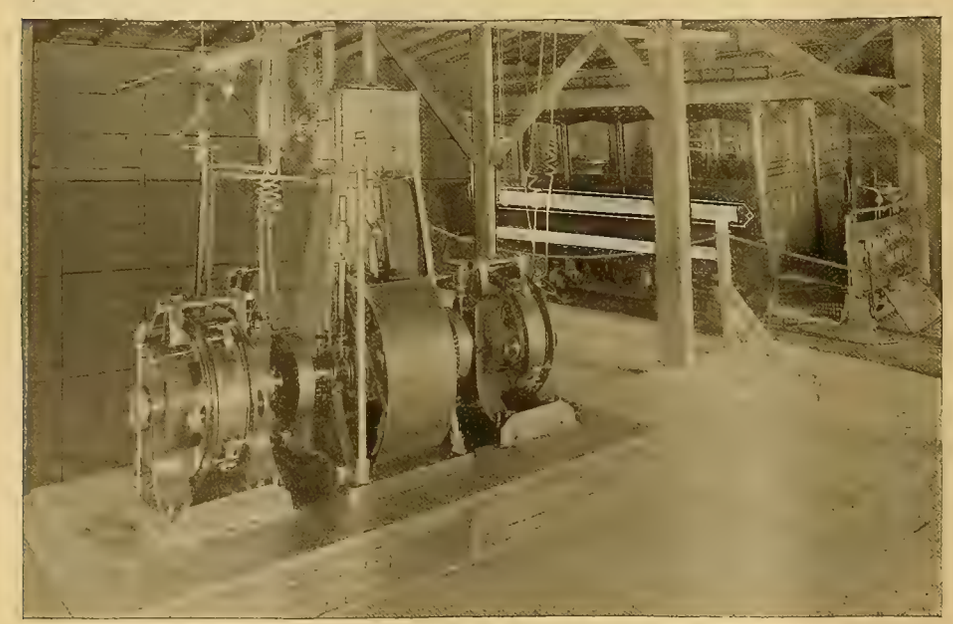


FIG. 1. JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

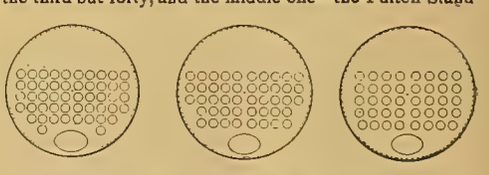
Cutter's Arc Insulator.

One of the sources of danger and annoyance in arc light work lies in the grounding of arc lamp frames, especially in damp weather. In planning to avoid existing defects, George Cutter, whose latest device is shown in the accompanying illustration, seems to have combined the good qualities which a device of this sort ought to have. He gives the body of his insulator the form of a double petticoat bell so as to lessen the chances of water creeping across and also to increase the surface resistance. Instead of using glass or porcelain he makes this insulating bell of hard rubber, which is less apt to have a film of moisture form on its surface. The screw eye at the top and the snaphook at the bottom are both threaded into strong bushings moulded into the rubber, all parts being planned for ample strength. The completed device is but twice the size of the illustration. It is made and exploited by George Cutter of Chicago.

CUTTER'S ARC INSULATOR.

Fulton Tubular Boilers.

The steam boiler is very near to the heart of almost every electrical central station man. For this reason the claims of boiler makers command attention especially in these days of close competition when the most careful economy is necessary to insure money making. In the accompanying diagram are represented three 60-inch boiler heads, all spaced with four-inch tubes. The first shows fifty tubes; the third but forty, and the middle one—the Fulton Standard—forty-six, with center spaces. Regarding these types John T. Caulfield of the Fulton Steam Boiler Works, Richmond, Ind., reasons as follows: "Some people think that plenty of tubes crowded in is really horse power; some people argue that forty tubes is enough. All we say is that people who pay coal bills and use hard, limy water know that they can take ten tubes out of the first and improve its steaming qualities and cut down repair bills. Isn't ours a good middle ground? Why is it that 'figured' heating surface is so valuable in an estimate for horse power? It is a paradox to manufacturers that reduction of this much-vaunted 'heating surface' is an increase of steam, even from less fuel, yet hundreds can testify to the truth of this statement." The firm is in a position to produce figures of economy.



FULTON TUBULAR BOILERS.

The work of changing the Prytania street car line in New Orleans, La., into an electric line has been commenced.

Electrically Illuminated Wagon in New York.

The accompanying illustration, Fig. 1, shows the electrically lighted advertising wagon of Keith's Union Square Theater, New York. Its equipment consists of 32 chloride accumulators of 200 ampere hours capacity each, furnished by the Electric Storage Battery company, Drexel building, Philadelphia. The cells are in four boxes, eight to the box, each box weighing, complete, about 400 pounds. Sixteen cells compose a set, which is in use on the wagon while the remaining set is being charged. The wagon, the interior of which is shown in Fig. 2, is wired with extra heavy rubber covered No. 12 wire and a No. 14 specially made black silk cord runs from the wagon to the horses. The wagon carries 15 28 volt 16 candle power De Khotinsky lamps in Edison sockets, and each of the four horses carries two 30 volt 16 candle power lamps of the same make in Swan sockets, which are fastened between the ears and on the saddle. Bryant switches control the four circuits, two on the wagon and one each on the leaders and wheelers. The batteries are charged from the theater plant in a small house built for the purpose in the rear of the main building. The wagon has been used in Boston, Providence, Philadelphia, Brooklyn and New York, and has made extended trips through the suburbs of these cities. As an advertising novelty, it has been a great success and never fails to attract attention.

Electric Power Transmission.

The accompanying cuts illustrate the electrical equipment of the Columbia, S. C., Mills company's cotton mills, installed by the General Electric company. Water power is utilized, and to increase the efficiency of the system it was decided to directly couple the dynamos to their turbines, although the available head, 25 feet, introduced a

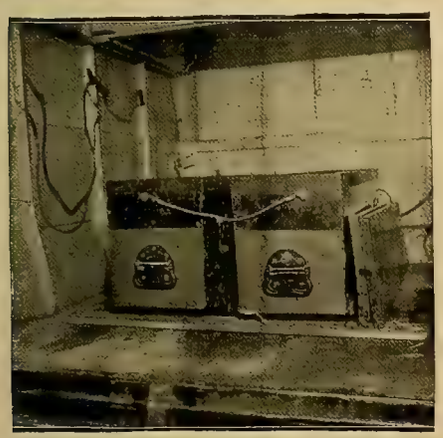


FIG. 2. ELECTRICALLY ILLUMINATED WAGON IN NEW YORK.

serious limitation in the possible speed. The total amount of power to be transmitted was over 1,000 horse power, and this was divided into two units at the generating station. Two special slow speed triphase generators were designed to meet the requirements of the case. One of these machines of 500 kilowatt capacity is shown in Fig. 1. It has forty poles and operates at a normal speed of 108 revolutions per minute, giving thirty-six cycles upon the line, at a voltage of about 575 at the dynamo terminals. The armature is ten feet in diameter, and is of singular and massive construction. It is of the iron-clad type and is wound with a single bar per slot, heavily insulated, a construction which gives practical freedom from burn-outs and other electrical difficulties. The total weight of the machine is about 100,000 pounds.

In the mill there are seventeen 65 horse power motors hung overhead and driving sections of line shafting with direct belting. One of these motors is shown in Fig. 2. The speed of the motors is 535 revolutions per minute, and varies less than two per cent. from full load to friction load. These machines have neither commutators nor collecting rings, and even the armature rheostat requires almost no attention, as it is operated from the floor by means of a lever thrust into the switch socket.

The plant is not yet all in place, but on April 24th the big generators were started and the motors given a preliminary spin.

National School of Electricity.

Announcement was made last week of the organization of the "National School of Electricity," with headquarters at Chicago. J. Allan Hornsby is secretary of the organization. It is announced that the lessons will be prepared in the form of printed sheets. The classes will meet once a week and the meeting will take the form of review work with lectures and practical demonstrations by the instructor. Forty lessons are to constitute the school year. The curriculum as outlined in the prospectus is meant to cover first the foundation principles of electricity, and then proceed directly to the construction and operation of all forms of electrical apparatus.

Central Station Lighting in Australia.

From a modest beginning the central station electric lighting business of Australia is assuming important proportions, and with encouragement seems to be destined to the same success that has marked its introduction everywhere. At Sydney, for instance, according to a correspondent of the London *Electrical Review*, there is a diminutive central electric lighting station which is deserving of notice. The proprietor of a ham and beef shop, who also manufactures sausages by means of a machine driven by a gas engine, being no doubt dissatisfied with the load factor of the plant, conceived the idea of utilizing his gas engine to manufacture sausages during the day and electricity by night. The project having been carried into effect, it naturally followed that the electricity was sold to neighbors for the purpose of illuminating their shops. Eight of the neighbors have seized the opportunity and dispense their goods under the light shed from incandescent lamps; a ninth neighbor, a draper, being content with an arc lamp hung over the footpath to attract the passer-by to examine his wares. The total lights installed amount but to 2 arc lamps and 33 incandescent, but they are distributed among two drapers, a jeweler, fruiterer, tobacconist, grocer, dressmaker, confectioner and wine-

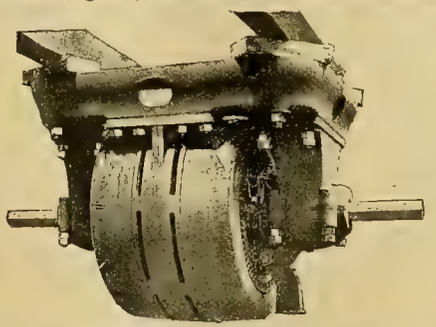


FIG. 2. ELECTRIC POWER TRANSMISSION.

shop. The Moss Vale central station, situated in a fashionable health resort, 2,200 feet up in the Southern mountains, commenced some three and half years ago with a 100 volt 65 ampere Manchester machine, driven by a Robey vertical engine and semi-portable boiler, supplying about 30 street lights and a few private ones by means of bare overhead mains run on insulators. It has recently been extended by the addition of a 25 unit Kingdom alternator, driven by a 50 horse power compound noncondensing Willans engine coupled direct steam being supplied at 120 pounds. pressure from a locomotive type boiler. The capacity of the station is 500 16 candle power incandescent lamps, but at present only about 140 have been taken up, including about 40 street lamps, the private supply being divided among about 20 consumers. One of the principal difficulties met with at present is due to occasional failure of the water supply, on which occasions the water has to be carted at a cost of about £2 per week, considerably more than the cost of coal—the coal used being about two tons per week, at 11s. per ton.

Power Transmission in Australia.

The Hillgrove & Armidale Water Power Electric company has secured by act of parliament certain water rights on the Guyra river, in New South Wales, Australia, and has entered into contracts with the mines at Hillgrove to supply power for the working of the machinery. The Hillgrove & Armidale company, has accepted the bid of the Crompton Electric Supply company of Australia for carrying out the entire plant. This plant will convey 400 horse

FIG. 1. ELECTRICALLY ILLUMINATED WAGON IN NEW YORK.

power from the Guyra Falls a distance of over five miles to the Baker's Creek and Eleanora mines, the continuous current three-wire system being adopted. The water is brought by fluming for some distance along the banks of the river to a position where a vertical fall of 500 feet is obtained with a minimum expenditure of pipes. At the foot of the pipe column three 450 horse power, Pelton wheels are to be placed, driving three generators.

A New Use for Electricity.

Writing in the *Atlantic Monthly*, Joseph L. Brent discusses "War's Use of the Engines of Peace," and he proposes some novel plans for military attack and defense. He says: "Electric current of enormous energy, capable, under the condition of actual contact, of destroying life in any number of men exposed to it, and possibly ships of war also, can be generated at points thirty miles or more distant from the localities where they are expected to be used, and be transferred there with inconsiderable decrease of power. Inflammable oils can be conveyed through pipes by gravitation, or pumps working, if necessary, twenty miles from point of discharge, and after discharge can be instantaneously ignited whenever desired, and, when discharged upon or under water, will float and burn upon its surface. Thus, electricity and inflammable oils meet the primary consideration of possessing centers of supply and activity remote from the enemy, and of developing powers capable of almost instantaneous transmission to points where they could operate effectively against an enemy, with a continuous renewal and supply of power; and therefore currents of electricity and inflammable oils, separately or jointly, are well adapted for use in defensive war." In

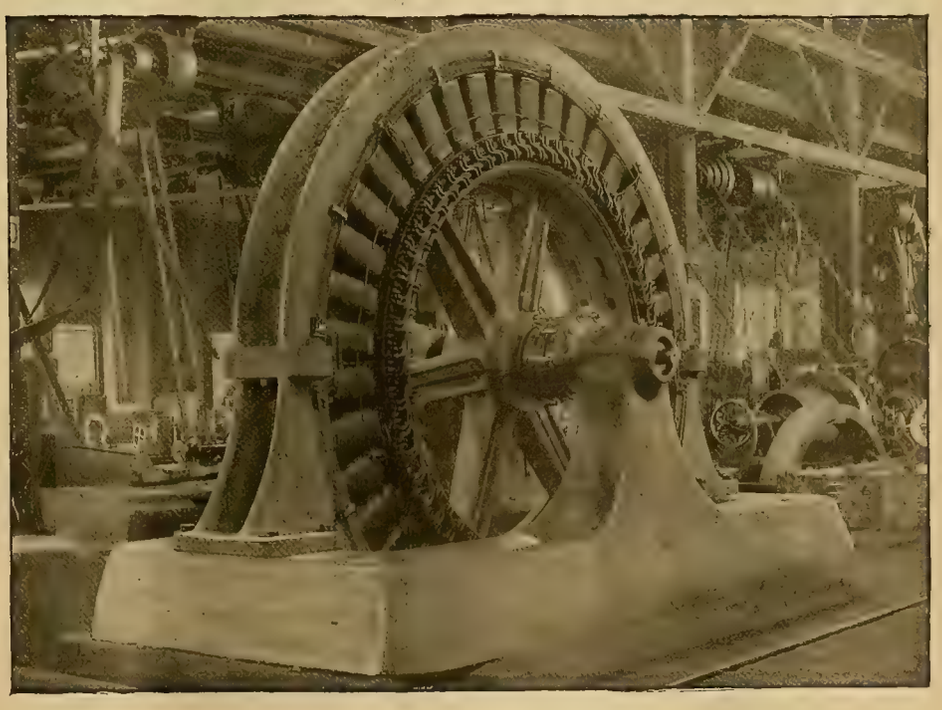


FIG. 1. ELECTRIC POWER TRANSMISSION

fighting on land Mr. Brent would have his electric generators carried on railroad trains, arguing that, as things are now, all important campaigns are conducted in close connection with transportation lines.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 7.—The rapid transit bill, as framed by the Chamber of Commerce and passed by the Legislature, with the referendum clause, remains in the governor's hands. It was made the subject of a long hearing last week at which both sides of the question had opportunity for presenting the clauses of the bill for discussion. The hearing was attended by a party of prominent New York business men, and much enthusiasm was shown in behalf of the bill. Governor Flower has not committed himself yet in either direction, but those near him express the belief that he will not use the veto. It is safe to prophecy that should he do so, it would be the most unpopular act of his term. The people of the state in a general way appreciate the needs of New York city, and reason that what will be of such benefit to the metropolis cannot fail to indirectly be a source of prosperity to the state at large. At the very best much delay is inevitable. After the mayor's approval the bill will undoubtedly be put before the people for consideration at the next election, and the obstacles incident to any great public improvement will drag matters for some time. However, although there are portions of the bill to be regretted, the situation is full of hope, and the time may be near at hand for the construction of an underground, electrically operated road, which is without question the desire of the people.

It is reported that the Metropolitan Traction company has been paying considerable attention lately to several plans for underground trolley systems. John D. Crimmins, of the company, is reported as saying that two systems have been investigated, and that the companies back of the systems are ready to put in operation five miles of track. Their confidence in their systems, Mr. Crimmins said, was such that they were willing to do this at their own expense, agreeing to remove it again, if, after a fair trial, the Metropolitan company is not satisfied. H. H. Vreeland, president of the company, also stated that the underground idea was under consideration, but that nothing definite had been determined upon. In speaking of the $50,000 prize offered by the Metropolitan company some time ago, Mr. Crimmins said: "Our $50,000 offer brought forth three or four thousand methods of operating cars by electricity. They came from France, Germany, Austria and Italy, and even members of Parliament communicated with us and said they proposed to take the first steamer over here to elucidate their ideas. We had hard work to stop them by cable. Nothing having been accomplished by February 1st, and as our $50,000 offer no longer held good, we have simply started on a new tack." W. F. O.

New England News.

BOSTON, May 5.—The report of the aldermanic committee on overhead wires made an unexpectedly favorable showing of what has been done toward burying the wires in this city. But two companies using high potential wires have failed to put them below ground, and one of these has already petitioned for rights to construct a conduit. There then remains but the West End Street Railway company against which to aim compulsory legislation. While it is acknowledged that many of this company's wires must necessarily be exposed to operate its system in the present condition of electric transit; it would appear that at least two-thirds of its wires are not so affected; that out of the 227 miles of line it controls but 75 miles represents the trolley wire, the rest being but auxiliary to it. It is against this other two-thirds, the feed wires, that the report of the committee is directed. The order appended, in brief, provides that all feed wires of the company in the district between Dover and Berkeley streets and the water front be buried before November 1, 1894; that leave to lay conduits for the same be thereby given in those streets now occupied by the system, and that permission be also thereby given to use such conduits for the trolley wire also, that the company may experiment with a view to placing the trolley wire underground as well, without further leave. The committee backs up its suggestions with a forcible report, relying principally upon the arguments of the impairment of the efficiency of the fire department, the well-known attitude of ex-President Whitney in urging substantially the same plan upon the road in 1893, and the failure of the road to live up to its bond to put its "power and feed wire under ground or insulate it where it is above ground and exposed." While nominally these wires are so insulated, in reality this insulation has become impaired through length of service until heavy moisture or rain soaking through the covering acts as a conductor, and makes these feed lines, with their heavy charge of electricity, practically the same as naked wires. The board had the consistency to call for an estimate of the cost of putting the one thousand miles of wire used by the city underground, of which but a paltry one hundred and twenty miles is now buried.

S. P. D.

Milwaukee, Wis.

MILWAUKEE, May 5.—For some time Oshkosh has been in the throes of an electric railway franchise fight. Not long ago H. C. Allen and H. L. Smith of Indianapolis proposed buying the horse car line already established in Oshkosh and extending it. Soon afterward J. K. Tillotson of Toledo, O., made a similar proposal. He said that he represented Toledo and St. Louis capitalists. The directors of the Oshkosh Street Railway company told him that the Indianapolis people had an option on the road. Mr. Tillotson consulted with several leading members of the Oshkosh real estate board and announced afterward that he would apply for a franchise whether the Indianapolis gentlemen bought the established street railway or not. He proposed to build eight miles of road at once and to build eight miles more within a year. Instead of building on Main street he proposed to build on the streets next to and parallel to Main street. He intended to have the line run to the suburbs of the city. Some time afterward it was announced that the Indianapolis gentlemen had purchased a controlling interest in the local company and would reorganize it as an electric road. The sale, however, was conditioned upon the council amending the franchise of the old company so that electricity could be used instead of horse power. Both of the contending interested factions asked for a franchise from the council. The matter is pending in that body now, and it may not be settled for some time. The advantage seems to be on the side of Mr. Tillotson. The real estate board is solid for him and he claims to have secured a right of way for an electric line running from Oshkosh to Kaukauna, which he proposes to operate in connection with his Oshkosh line. The members of the franchise committee of the council also seem to incline his way. The old company and its adherents declare that Tillotson is only a promoter; that he has no capital and wants the franchise in order to speculate with it. He, however, is willing to give a bond as a guaranty of good faith, he says, and it is charged on his part that the old company is asking for a franchise that it knows it cannot get for the purpose of staving off matters until it can obtain its own price.

The town of Greenfield authorities have granted a franchise for an electric line from the present terminus of the National avenue branch, near the Soldier's Home, to the state fair grounds, and thence to North Greenfield. The company, however, wants a bonus from the State Agricultural society and other inducements as well. There is no object in building the line, the officers of the company state, simply for six or seven days' state fair business.

General Manager Wyman, of the Milwaukee Street Railway company, has issued an order appointing S. G. Coleman general superintendent of the Edison Illuminating company. Mr. Coleman has been general superintendent of the Badger Illuminating company since its start. He is an able, experienced electrician, and an excellent business man. He is now the superintendent of both companies, and has charge of the incandescent light business as well as the arc light business of the Milwaukee Street Railway company.

The plant and assets of the South Milwaukee Electric Light & Power company have been sold to the Western Electric company of Chicago. The sale was made by the receiver, Henry Jane. The purchasers are operating the plant, but do not expect to retain possession of it. It is probable that the old company will be reorganized.

General Manager Wyman of the Milwaukee Street Railway company states that that corporation will not be affected by the outcome of the electric motor infringement suit of the Adams Electric company against the Lindell Railway company, recently tried at St. Louis. The suit affects the validity of the patent under which the Sprague motors are manufactured. Very few Sprague motors are used on the Milwaukee lines, Mr. Wyman states, and the General Electric company, whose later motors are used here almost exclusively, is under contract to protect the company against any claim for infringement.

A definite form is being taken by the project to build an electric railway through the Fox River valley. The Tillotson company of Toledo and St. Louis has made application to the county board of Outagamie county for a franchise. It is proposed to run the line from Neenah to Kaukauna, along the west side of the river, passing through Appleton and Little Chute and connecting with Kimberly and the combined locks on the east side of the river by means of foot bridges. It is probable that the present line through Appleton will become part of the valley system. The line may be extended to Oshkosh if the Tillotson company gets the franchise. The company agrees to begin work on the road within ninety days after the franchise is granted, and the line may be completed by next fall. The proposition is to charge 10 cents between the towns and 25 cents over the whole line. The county board considered the application for a franchise about May 1st.

Within three months the streets of Janesville will be lighted by electricity. A proposition by Capt. Pliny Norcross has been accepted by the common council of that city, and for the next three years he will supply the streets of the city with seventy-five arc lights. The lights will be kept burning until 3 o'clock in the morning.

Work on an important extension of the long-distance telephone service of the state will be begun in a few days. A metallic circuit line is to be built from Appleton to Marinette, taking in Oconto, Green Bay and other intermediate points. The extension will permit the people of Northeastern Wisconsin to talk with Milwaukee, Chicago and New York. Another long-distance line is to be built from Oshkosh to Appleton.

Oshkosh is said to favor the idea of a municipal electric lighting plant. Mayor Oellerich and Aldermen Neumann and Mueller recently visited Bloomington, Ill., for the purpose of inspecting the municipal plant at that place. The cost of the Bloomington plant, which is in the same building with the water works plant, was $73,000. It was built four years ago. The Oshkosh officials state that it could be duplicated now for about $50,000. The cost per lamp in Bloomington is $60 a year. The lamps are 2,000 candle power and they burn all night. Engineers have been at work making estimates of the cost of a plant of the size needed by Oshkosh. The affairs of the Oshkosh Electric Light & Power company do not seem to have been settled yet. The Massachusetts Loan & Trust company, which holds the deed given to secure $100,000 worth of bonds, still threatens to foreclose unless a settlement is made. The only way out of the difficulty, so far as the stockholders are concerned, is a re-organization, and the outlook for that is not very bright, in view of the talk of establishing a municipal plant.

The retrenchment policy of the Milwaukee Street Railway company is manifesting itself. R. S. Stikeman, for three years past superintendent of construction of the Milwaukee railway system and of the Edison Illuminating company, has presented his resignation, which took effect May 1st. James Motley, superintendent of illumination of the Edison company, has also resigned. Both gentlemen will return to New York, where they formerly resided, and will no doubt find lucrative positions. They have done excellent work while employed by the company. The principal reason for their retirement is the fact that the company is cutting down expenses wherever it can be done without crippling the service. The entire business of the syndicate is gradually being consolidated with a view to securing better results and more economical management. The work which has been performed by Messrs. Stikeman and Motley will be divided among other officials of the company. Manager Coleman, of the Badger Illuminating company will probably look after the entire lighting business of the syndicate, the incandescent as well as the arc. Another reason for the retirement of Mr. Stikeman is the fact that the principal work of construction has been done.

The connection of electricity with fires is a question that has been discussed very much of late as a result of the Davidson theater fire, in which nine firemen lost their lives. It is suspected from the start that the fire was caused by defective electric wires or by the range used in the kitchen of the Hotel Davidson, which was located just above the auditorium of the theater. The building inspector and the officials of the board of underwriters, including the electrician employed by the board, supported the electricity theory, while Chief Foley of the fire department supported the theory that the fire was caused by the kitchen range. At the inquest Superintendent Stevens of the Board of Underwriters stated that he and Mr. Bennett, the board's electrician, had inspected the theater a number of times, and twice at least had notified the management that the wiring was defective. According to Mr. Bennett the wiring was in very bad condition, and he was strongly of the opinion that it had caused the fatal fire. W. P. Tait, the electrician of the theater, said that there were ten lights in the kitchen, where the fire broke

out, with two circuits, properly insulated with rubber tubing. The wires over the kitchen floor lay on the joists, but there was no danger, as the work was a first-class job at the time that it was done. It could be improved, of course, as a result of advancement being made in the art. All the electric lights had been cut off four hours before the fire broke out. The building inspector, after stating that in his opinion the fire was caused by electric wires, said that the city ought to have an electric wire inspector, the new office to be connected with the building inspector or with the fire department. The jury found that the fire originated from the range in the kitchen. It recommended, however, that the electric wiring in all large buildings be inspected under the direction of the building inspector of the city, and that such inspector pass upon and make reports of such electric wiring, and that the officers of the Board of Underwriters report to the fire department all defects in buildings or in electric light wiring that it inspects. The Board of Underwriters lost no time in acting in the matter. A meeting of the full board was held, and it was decided to take every measure possible to insure proper wiring. The details were left to the directors, who met April 18th, and issued an order that all defective wires must be repaired without delay, otherwise the insurance policies would be cancelled. The work of making a thorough inspection will be prosecuted with vigor, and notices of defects will be sent out as soon as the defects are discovered. C.

PERSONAL.

William H. McKinlock, president of the Metropolitan Electric company, Chicago, has returned from a business trip through the East.

The friends of General Manager B. M. Downs of the Bushwick Glass company of New York will be pleased to hear that he has recovered from his recent illness and is able to attend to his business.

NEW INCORPORATIONS.

Electric Conduit company, Sturgeon Bay, Wis.; capital stock, $1,000; John S. Hay, Green Bay, Wis.

Imperial Electric Lamp company, New York, N. Y.; capital stock, $250,000; John F. Wood, Huntington, N. Y.

ELECTRIC LIGHTING.

A contract has been closed with the General Electric company for a 1,200 incandescent light alternator for Appeal, Mich. A meter service will be given.

Schoharie, N. Y., is to have an electric light plant. The location for the plant has been secured, and, as there is ample water power the business, it is thought, can be started at very reasonable prices.

The Royal Electric Lighting company of Montreal, has secured the contract for an incandescent plant for Mitchell, Ont. The plant is to be of five hundred light capacity, and will be put in during the summer months.

A peculiar accident happened in Braddock, Pa., April 20th. Morris Lee, twenty-eight years old, an employe of the Carnegie Steel company, was instantly killed by an electric shock. A steel bar in his hand came in contact with an electric light wire, turning 3,000 volts through his body.

At the instance of some of the principal electric light companies, the Canadian government has decided to establish a system of inspection of electric meters similar to that already in force for gas meters. A bill for this purpose is to be introduced in Parliament at the approaching session.

The Mutual Electric Light & Power company, Chicago, has informed Corporation Counsel Rubens that it will accept the ordinance recently passed authorizing it to lay wires in conduits for the purpose of supplying electric light and power in the district south of Thirty-ninth street and west of State street.

Lyon & Healy's new music establishment at Adams street and Wabash avenue, Chicago, is being wired for 42 low tension arc lamps and 1,000 incandescents. The Chicago Edison company is doing the work, and great care is taken to make a model equipment. Current will be secured from the down-town Edison station.

The Milwaukee Arc Light company, Milwaukee, Wis., is making an effort to establish enough patronage in the down-town district to warrant the laying of underground wires. If sufficient patronage cannot be obtained the field, it is said, is likely to be vacated by the company as it is at present under orders to remove its overhead wires.

The electric station at Attleboro, Mass., which was burned some time ago, is being rebuilt and will soon be in condition to furnish current for light and power in the place. The contract entered into between the town and the electric company for street lights will be carried on when the town desires to continue the street lighting.

A disastrous fire started in the engine room of the Royal Electric company's incandescent light station at Montreal, Que., May 1st. The engineer had not time to shut down his engines before fleeing for his life, and soon after the fly wheel burst, a portion being hurled through the roof and falling to the street below. Two workmen were hurt. The loss is about $100,000, fully covered by insurance.

The lamp and electricity committee of the Rochester, N. Y., Common Council has under consideration an application from the Central Light & Power company, asking that the right to construct underground conduits on Main street for its wires be granted the company. The plan the petitioning company suggests, is to get the council's permission to bury the wires directly under where they are now strung. If this plan is adopted the work will have to be done without disturbing any existing right in the street which the common council has already granted.

A large isolated incandescent plant has been sold to John M. Smyth by the Chicago Edison company for installation in Mr. Smyth's building on West Madison street, Chicago. It comprises four Edison compound wound bipolar machines—two of 60 kilowatts each and two of 45 kilowatts each—having a total capacity of 3,600 lights. Two New York safety engines of 160 horse power each will drive the dynamos. The new plant supersedes an electric lighting equipment which was much smaller. It will be one of the largest installations in Chicago in a purely commercial establishment.

Kingston, N. Y., was in darkness for a period beginning April 14th, owing to a disagreement between the Kingston Electric company and the common council. The company controls every light, both gas and electric, in Kingston. At a meeting held some time ago the common council decided that the electric light company was not keeping its contract, and notified it to discontinue its service in city streets and public buildings May 12th. The company illuminated Kingston city at its own expense two nights but afterward shut off all its lights. Many of the property holders were indignant at the extra hazard their property is put to on account of no lights in the engine houses and an arrangement to obviate the danger will be made as soon as possible.

A verdict of $787 was given in the Superior Court of Massachusetts for Matthew J. Connor against the Boston Electric Light company April 25th. The case was given to the jury in the Superior Court, involving $3,000 damages. Matthew J. Connor, who was a telegraph operator of the Western Union Telegraph company, was injured while he was attempting to take in his umbrella on Court street, by reason of the end of his stick coming in contact with an arc light. It was raining at the time and he said that the lamp was only seven feet above the sidewalk. The umbrella having come in contact with the lighted lamp, he received a severe shock whereby his right hand was so badly injured that he has not been able to use it at his work. The electric light company denied any negligence on its part, but on the other hand, claimed that Connor did not use care in lowering his umbrella and looking out for the lamp.

ELECTRIC RAILWAYS.

A May Day meeting of the unemployed at Cleveland, O., took exception to the conduct of an electric motorman during a parade and attempted to mob the car. A riot seemed about to take place, but the men were finally led away.

The receivers of the Philadelphia & Reading Railroad company have decided to equip the section of its line between Fairmount avenue, Philadelphia, and Jenkinton, over which the suburban travel is heavy, with automatic signals. They have awarded the contract to the Hall Signal company, which will at once put in the automatic electric normal danger block signals of the Hall system.

The Presidio & Ferries company, San Francisco—the Union street line—propose some day, if it can be brought about, to equip the road with electric power. The company's present franchise doesn't permit electric power, and so it has asked the supervisors to amend the franchise by inserting "or the most approved electrical appliances, electric or other motors," after the words "cars to be moved by endless wire ropes."

The Consolidated company of Cincinnati seems to mean business. Last month it notified the board of aldermen that it was its intention to change all horse car lines into electrically operated lines as soon as possible. The company stated that it had placed orders for the new machinery, but that it would require some months for the firms to fill the orders. It asked permission of the board to economize the intermediate time by erecting poles and wires along the routes.

Upon the application of James Callahan and Eliza A. Greenough, owners of property on the route of the Englewood and Chicago electric street railway, Judge McConnell has issued a temporary injunction restraining the company from proceeding with the construction of the road in front of complainants' property, which is in the neighborhood of Vernon avenue and State and Seventy-first streets, Chicago. If the road were built according to present plans, the only ingress and egress to this property would be occupied by the tracks and poles of the road.

The city of Zurich, in Switzerland, has an electric street railroad of the trolley type in which an auxiliary storage battery equipment plays a prominent part. The road is a small one—scarcely three miles long—and there are altogether only nine cars in service. With a line so limited in extent the demand for current is subject to very wide fluctuations, and the load on the engines in the power station may rapidly vary from almost nothing up to the full maximum, giving rise to the most unfavorable conditions so far as economy of engine operation is concerned. With the aid of the storage battery plant, however, this is entirely avoided and a practically constant load is put upon the engines.

The street railroad projectors of Marion, O., have secured a franchise for twenty-five years, entirely acceptable under the existing general ordinance, which was reasonably amended. The board is composed of seven leading citizens, and has made Edward Durfee president and treasurer. Godfrey Leffler was chosen vice-president and George E. Turner, secretary, who will also serve as superintendent. All of the preliminaries have been arranged and the work of construction will begin at once. Four miles of the road must be in operation within five months. In conjunction with the building of this road the Marion Electric Light & Power company will add a large incandescent plant and complete power circuit.

MISCELLANEOUS.

A steam pipe in the works of the Southern Electric company, Philadelphia, exploded May 31. Larry Martin, the night engineer, was killed and several men were seriously injured.

The bid of the Utica, N. Y., Electric Light company for operating the Geneseo street bridge has been deemed reasonable and has been accepted by the state. The city will be called upon to pay the cost of operation.

During a storm in Chicago recently two men were struck by lightning and killed and several others rendered unconscious. The men were at work upon a lumber pile about ten feet from the ground and continued to work until the lumber was thoroughly soaked by the rain.

Steps will be taken at once to put all the telegraph and telephone wires in Syracuse, N. Y., within a mile of the center of the city underground. A year ago a law was passed giving the common council the power to order the wires underground at any time, and the mayor believes that now is the time.

The entire electric plant of the Capitol Gas company, which holds contracts for lighting Sacramento, Cal., and running street cars, burned, April 18th. Twenty-four dynamos were burned and half a dozen of the most powerful engines on the coast were practically destroyed. The plant was one of the largest on the coast, and contained the finest modern machinery. The loss amounts to $300,000.

The Burton Electric Heating company has been organized as a subsidiary company of the Electric Forging company for the New England states, and will operate the patents of the company in that district. The capital stock of the new company will be $1,000,000. The factory will be at Woburn, Mass., and its office in Boston. The officers are: President, George D. Burton; treasurer, F. J. Hutchinson.

City Electrician Johnson of Tacoma, Wash., met with a painful accident recently. One of the incandescent machines in the city's electric light station broke down and in attempting to overload another machine a fuse blew in his hands while he was in the act of substituting one of a greater carrying capacity. He was knocked off a chair and narrowly escaped becoming entangled in a belt. His left hand was badly burned by the current, and had it not been for the quick action of an assistant more serious consequences might have resulted.

The West Virginia University is building a mechanical laboratory adjacent to its mechanical shops, in which the light, heat and power plant of the university will be installed. Having this plant all under the same roof in the department of mechanical engineering greatly increases the facilities for instruction, as the whole plant will be available at any time for experimental work and special testing and investigation. The equipment will comprise a storage battery plant, arc and incandescent dynamos and motors, electrical testing and measuring instruments, simple and compound engines, installed so as to work as a triple expansion engine of 100 horse power, exhaust-steam and independent jet and surface condensers, compound pumping engines for reservoir, service and duty tests, high pressure sectional boilers, set for coal and natural gas firing, and the present equipment of standard engineering testing and measuring instruments and accessories will be materially increased. Estimates will be received upon the above apparatus. The university is located at Morgantown, W. Va., on the Monongahela river, and on the new line of the Baltimore & Ohio railroad connecting its Pittsburg and Wheeling lines.

In accordance with the usual practice the College of Mechanics and Engineering, University of Wisconsin, has in its announcement for 1894-95 called attention to the inducements that the institution offers to those designing to take a course in mechanical and electrical engineering. The university is particularly fortunate in its library facilities. Beside the university library, containing more than 30,000 volumes, of which a good there are books pertaining to the engineering profession conare the library of the State Historical society, 150,000 volumes, and the city library, 13,000 volumes, to which the students have free access. The department of electrical engineering is under the charge of Professor D. C. Jackson and Professor John E. Davies, who have a number of competent assistants. The course is practical and exhaustive, and special instruction is provided for those desirious of teaching. There are three methods of obtaining admission to the university, by examinations at the university, by special local examinations and by possessing certificates from accredited schools. The regular examinations of the university are two in number; one in June and one in September. For the current year the earlier examinations will be held on Thurday and Friday, June 14th and 15th. The later examinations will be held on Tuesday and Wednesday, September 11th and 12th. Examinations will also be held on the opening day of the winter and spring terms. Candidates must be present at the first examination of the first day.

TRADE NEWS.

The terms of agreement entered into by the Otis Steel company, Cleveland, O., for the Warren-Webster vacuum heater show that economy is made the strong point in its sale.

Last week the Chicago office of Westinghouse, Church, Kerr & Co. was removed to 1204-5 New York Life building. Here the western representatives will have every opportunity for pushing the sales of the Westinghouse engines, which have made such a splendid showing in the West.

The Sprague-Pratt Elevator company of New York has recently received the contract for placing three of its electrical elevators in the Merchants' National Bank building, and also two elevators for the McCoy Hall extension to Johns Hopkins University at Baltimore, Md. The office of this company is visited daily by representatives from large office buildings throughout the country who are contemplating the change from the hydraulic service. The work done by the company in the Postal building, New York, is giving perfect satisfaction and attracting much attention.

Thomas H. Fearey, manager of the Buffalo office of the General Electric company, reports a large spring business. The Buffalo Railway company has ordered two 800 kilowatt direct-coupled generators, which will be placed in the present power station and coupled to Lake Erie upright engines. These will be duplicates of the couple which did such fine work at the Intramural station at Chicago. The company has also ordered G E-800 motors for 84 new cars. The West Side Railroad company of Elmira has purchased two new equipments. The Kingston City Railway company two; the Seneca & Waterloo Railway company one, and the Buffalo & Williamsville Railway company two G E-800 equipments. The palace car which has been used by the General Electric company for exhibition purposes has been purchased by the Buffalo, Bellevue & Lancaster Railway company. Lighting plants have been installed at the Barber Asphalt Paving Works and the Atlas Works of the Standard Oil company. A fine trade has been done in railway and lighting supplies and incandescent lamps, and many large orders have been reported.

The electrical trade in general will be interested to know that Fred A. Van Namee, who was president and treasurer of the late Muncie Electrical Works, Muncie, Ind., has recently obtained control of the company's entire business and plant and is now in a position to push the business, making it practically a new concern. The new firm name will be the Muncie Electrical Manufacturing company, and Mr. Van Namee proposes to make it a synonym of standard efficient machinery at low prices. The success of the Muncie type of machine is already established, and it is Mr. Van Namee's purpose to refine it in every particular. The company is now in a position to furnish constant potential motors in capacity from one to 50 horse power, either for 110, 220 or 500 volt circuits. Incandescent dynamos are made in sizes from 18 to 700 lights capacity, to run at 125, 250 and 500 volts. It will be remembered that the most valuable feature of the Muncie machine is the fact that its field magnet is one casting of solid cast steel. The gain in efficiency by this construction is claimed to be remarkable. Another valuable specialty which will be likely to add to the company's reputation for good work is a new type of fan motor recently perfected and now ready for the spring and summer trade. This little machine is of unique design and contains a number of novel features. With the finely equipped factory and other facilities which Mr. Van Namee now has at command, backed up by his well-known qualifications and high business standing, it is only reasonable to presume that the Muncie Electrical Manufacturing company will secure a good share of the present increasing trade.

BUSINESS.

The Chicago Insulated Wire company is located in its new offices, 414-416 Northern building, and is prepared to furnish without delay all sizes of fine magnet, weatherproof, office and annunciator wires from Chicago stock.

E. W. Bliss & Co., New York, have removed their Chicago office to 100-104 West Washington street. The firm is making a specialty of presses, drop-hammers, shears and sheet metal machinery. The Chicago office will be in charge of C. W. Ellsworth.

The Chicago office of the Westinghouse Electric & Manufacturing company has been removed to the suite of offices, 708–711 New York Life building. The rooms are well lighted, and will undoubtedly be an improvement in location over the old quarters.

The new P. & B. cigar, bearing the compliments of the Standard Paint company of New York, pronounced, like this well known compound, "not good but the best," is being distributed among the company's many friends by General Sales Agent F. L. De Rende.

Montgomery H. Johnson has resigned his position as treasurer and electrical engineer for the Gibbs Electric company of Milwaukee. Having completed the designs for the machines the company intends to manufacture, Mr. Johnson is about to go into business in Utica, N. Y., where he will open a consulting office.

Albert and J. M. Anderson, inventors of electric railway devices as well as the Ætna railway insulators, have recently received flattering indorsements from some of the most prominent engineers in Europe for their insulators, which have been subjected to most severe tests and have proved themselves superior to anything else now in use. This is the real reason why this firm enjoyed such unusual prosperity all through the serious commercial depression which has so long continued.

T. J. Murphy of New York has recently moved into larger quarters in the Electrical Exchange building to meet the growing demands of his business. He is showing some fine samples of slate for switchboards in new designs in imitation of various woods. The growth and continous success of this branch of Mr. Murphy's business is marked.

The Wallace Electric company, Chicago, is permanently located in its new store, 307 Dearborn street. With increased facilities and a well assorted stock, the company is prepared to ship promptly all orders for its standard electrical materials and specialties. One of the principal articles the company is pushing is the W. W. lightning arrester. This arrester is simple, durable and effective, and is made for power, railway and lighting circuits.

The balance sheet of the Chicago branch of the Ansonia Electric company for April shows the assets to be $197,-918.73 and the liabilities $116,436.35. Since the report of March 1st an inventory of the stock has been made, and the value calculated on revised figures which would show that on the new valuations which have been placed on the stock the value of the stock would be about $25,-000. In figuring the value of stock prices have been made which would be realized in continuing the business on its present basis, the values which have been given the different articles being such that there will probably be no trouble in disposing of them at the figures which have been set, the same being below the prices which the goods would be sold for in the ordinary course of business.

The Western Telephone Construction company, whose offices are at 540 Monadnock building, Chicago, recently installed a telephone exchange in Albert Lea, Minn., which has been giving excellent satisfaction, and which is spoken of in terms of warm commendation by the people of that place. The distinguishing feature of the system controlled by the Western company is the Strowger automatic switch and appliances. The preliminary directory in Albert Lea shows 50 patrons, including the newspaper offices, depots, waterworks and many of the principal houses and residences, and the indications are that the service will be rapidly extended. The success which its system has met with from its patrons is particularly gratifying to the Western Telephone Construction company from the fact that is has superseded an exchange of another system.

The Central Electric company, Chicago, has now become comparatively well settled in its new home, 173-175 Adams street. Here it is the intention to carry a line of electrical supply goods which in point of excellence and size will be second to none. The Central company has here ample floor space for the exhibition of its goods, and its well-arranged windows are the subject of considerable attention, not only from those interested in electrical supplies, but from many who realize merely that they are looking upon a well arranged exhibit of first-class specialties. During the last week a particularly heavy sale has been experienced for the Helios arc lamps, for both alternating and direct currents. Many inquiries are received daily concerning this type of lamp, which seems to be growing steadily in popularity. Another specialty which the Central Electric company has made a paying one is its metal-sheathed bushings. The demand for these bushings continues to tax the capabilities of the company to furnish this product upon demand. A visit to the new store upon Adams street will convince one that Chicago has now one of the finest equipped electrical supply houses in the country.

The Planté company, 27 Pine street, N. Y., has been organized to manufacture, sell and install all kinds of storage batteries. It is licensed under all the patents of the Accumulator company, including the Faure patent and vast number of improvements thereon, as well as under the Brush patents, It will also supply, in its most improved form, when desired, the type of battery first introduced by Gaston Planté. Now that the great Brush-Faure patent litigation has ceased to interfere with the progress of the art in America, it is believed that the country will not long remain so far behind England, Germany and France in the proper and economical use of storage batteries. In Europe there are already one hundred and seventy-five central stations equipped with them, and over three thousand private installations. In this country there are many cases where storage batteries are adapted to street cars; and there are large central stations dependent on the use of coal, which should look with favor upon the introduction of the storage battery; while its use for residences, office buildings, launches, etc., is too well understood to require more than passing notice. The Planté company does not present itself to the public with any phenomenal and untried devices. It solicits business on the ground that its product is already a standard, its engineering experience large, and its facilities great. This company, it states, will in no case advise the use of a battery, unless for purposes in which it will prove of distinct advantage to the customer.

ELECTRICAL PATENTS.

Issued May 1, 1894

518,939. Electric Conductor for Underground Conduits. Daniel E. Connor, Covington, Ky.

518,945. Dynamo-electric Machine. George Forbes, Niagara Falls, N. Y.

518,946. Construction of Solenoids or Coils of Wire Used in Electric Machinery. George Forbes, Niagara Falls, N. Y.

The solenoid is inclosed in a close-fitting covering or casing provided with inlets and outlets to admit of a forced circulation of oil, thus affording means whereby the circulating oil saturates the whole of the cotton or other insulation surrounding the wires and carries away the heat.

518,952. Trolley for Electric Railways. George W. Hooper, Rochester, N. Y.

518,959. Telephone. Eugenij V. Kolbassieff, Cronstadt, Russia.

518,966. Storage Battery. William A. Phillips and Justus B. Entz, Bridgeport, Conn.

The battery plate or element is formed from two flat spirals or lobes of insulated wire placed together, edge to edge, to form a mat, the spirals being secured together and each having exposed ends for connecting the same in circuit.

518,971. Electric Time Alarm. Henry P. Sommer, Chicago, Ill.

519,045. Electric Arc Lamp. Joseph B. McKeown, Cleveland, O.

519,076. System of Electrical Distribution. Elihu Thomson, Lynn, Mass.

The system comprises high potential mains and low potential secondaries, the transformer being placed in a vault beneath the ground, the high potential mains passing thereto by means of underground pipes, the secondary and the transformer case being connected to ground through a low resistance.

519,077. Storage Battery System. Jakob Trumpy, Hagen, Germany.

519,097. Field Magnet for Electric Machines. Albert Schmid, Allegheny, Pa.

519,098. Self-exciting Constant Potential Electric Generator. Albert Schmid, Allegheny, and Benjamin G. Lamme, Pittsburg, Pa.

The machine comprises an armature core, having supporting yokes, and carrying main armature coils, in series with which are connected regulating coils; regulating coils are connected also in series with supplemental armature coils, a conductor being provided for connecting the supplemental coils with the field exciting coils.

519,099. Incandescent Electric Lamp. Frank S. Smith, Pittsburg, Pa.

The lamp is provided with iron leading-in wires, the wires being embedded in a form of glass, having substantially the coefficient of expansion of iron. The glass is composed of silica, fifty to sixty per cent.; boracic acid, three and a half to six per cent.; sodium oxide, ten to twenty per cent.; borium oxide, thirty to forty per cent.; zinc oxide, five to six per cent.

519,115. Electric Railway Conductor Support. John C. Henry, Westfield, N. J.

519,116. Electric Motor. Frank E. Herdman, Indianapolis, Ind.

519,117. Electric Elevator. Frank E. Herdman, Indianapolis, Ind.

519,118. Elevator. Frank E. Herdman, Indianapolis, Ind.

519,119. Elevator Controlling Device. Frank E. Herdman, Winnetka, Ill.

519,120. Regulator for Electric Motors. Frank E. Herdman, Indianapolis, Ind.

519,121. Controlling Device for Electric Motors. Frank E. Herdman, Indianapolis, Ind.

519,122. Controlling Device for Electric Motors. Frank E. Herdman, Indianapolis, Ind.

519,123. Controlling Device for Electric Motors. Frank E. Herdman, Indianapolis, Ind.

519,124. Electric Motor Controlling Apparatus. Frank E. Herdman, Indianapolis, Ind.

519,142. Relay. Horace S. L. Verley, Hoboken, N. J.

519,171. Means for Introducing Insulating Material Into Conduits. David Brooks, Jr., Philadelphia, Pa.

519,188. Commutator Brush. Rudolf Kersberg, Hohenlimburg, Germany.

519,213. Automatic Electric Fire Alarm and Signal. Louis A. Werner and Clement J. Werner, Boston, Mass.

519,265. Burglar Alarm. Harvey A. Moore, Indianapolis, Ind.

519,272. Electric Motor. Elias E. Ries and Gordon J. Scott, Baltimore, Md.

The motor is of the alternating type, and is composed of several groups of sectional laminated and interlaced circularly arranged field magnets, and a concentric sectional laminated armature, and a commutator with circuit connections for shifting the polar lines of the field of force.

519,280. Electric Generator. William Baxter, Jr., Baltimore, Md.

519,281. Electric Motor or Generator. William Baxter, Jr, Baltimore, Md.

519,283. Electric Arc Lamp. John C. Fyfe, Chicago, Ill.

519,291. Electric Railway. William B. Purvis, Philadelphia, Pa.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents which expired during the week ended May 1, 1894:

190,127. Electric Stop Motions for Drawing Frames, Etc. John Bullough, Accrington, England.

190,191. Telegraph Sounders. Jesse H. Bunnell and Miles W. Goodyear, New York, N. Y.

190,198. Electric Station Indicators for Railways. J. I. Conklin, Jr., New York, N. Y.

190,206. Electro-magnetic Motors. W. W. Gary, Huntingdon, Pa.

190,391. Lightning Rods. N. Van Loon, St. Cloud, Minn.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, MAY 19, 1894. No. 20

Lighting Equipment of the Chicago Beach Hotel.

It is given to few hotels to be so admirably and extensively equipped for electric lighting as the recently erected Chicago Beach Hotel in Hyde Park, Chicago. With ample room on the shore of Lake Michigan, the management had the wisdom to provide a large, detached building for the power plant, with the result of possessing one of the best and most attractively arranged isolated stations in Chicago. It is indeed a relief to encounter a private installation for electric lighting housed above ground in a large, clean and airy building, and it is a pleasure to the WESTERN ELECTRICIAN to present the following brief description with accompanying illustrations.

The Chicago Beach Hotel is a large and imposing structure on the lake shore at the foot of 51st street, and the plant is of corresponding dimensions. The mechanical and electrical equipment, with a laundry, is contained in the not ungraceful power house illustrated in Fig. 2. The building is of yellow brick, conforming to the hotel, and is of ample size, the round brick stack, 185 feet high, being the prominent feature. Steam is generated in four Wickes tubular boilers, each 16 feet by 66 inches, and fired by Hawley down-draft furnaces, in which is burned Ohio soft coal delivered at the door on a spur of the Illinois Central railway tracks. The average weekly consumption of coal is about sixty tons. Steam is supplied for the elevator pumps, to the laundry and for cooking as well as for the engines operating the dynamos. The feed water heater is of the Excelsior type, and two Worthington pumps supply water to the boilers.

Two fine Fitchburg engines drive the dynamos, the arrangement being shown in Fig. 1. Both are of the tandem compound type, the larger one, shown on the left in the picture, having cylinder dimensions of 16 and 30 inches, with 36 inch stroke. The other, driving the smaller dynamo, has cylinders 13 and 24 inches in diameter, with 30 inch stroke. At 90 pounds initial steam pressure and at quarter cut-off the engines are rated respectively at 365 and 250 horse power. The dynamos are of the Brush direct current 110 volt type and are connected to the engines by direct rope gearing, the driven dynamo sheaves taking the place of pulleys on the armature shafts. The driving sheaves are respectively 15 and 14 feet in diameter. Hemp rope, seven-eighths inch in diameter, is used, and 2,800 feet is required for the two sets of gearing. The larger dynamo, on the left, is a 3,000 light machine, although it has carried 3 500. It is a massive piece of machinery, with four poles, and is operated at 500 revolutions per minute. The smaller machine, speeded to 950 revolutions, is bipolar and has a capacity for supplying 2,000 lights, so that the total generating capacity of the station is over 5,000 16 candle power lights. The dynamos are compound wound and are arranged for coupling in multiple.

The switchboard, Fig. 1, is made up of three panels of slate encased in a neat moulded framework, finished in old oak. Upon it are mounted an ammeter for each dynamo, an ammeter to show the total current for the entire plant and a Weston illuminated dial station voltmeter with compound voltmeter switch, which is employed to take readings of the pressure at different points throughout the hotel building by means of pressure wires. The necessary dynamo switches and a ground detector are furnished. All bus bars and fittings are of polished copper connected on the front of the board. The feeders, leading down from the back of the switchboard, are conducted underground in lead-covered cables to the hotel.

In the hotel and power house there are 5,850 16 candle power lamps connected to the electric lighting system, in addition to 13 low-tension arc lamps about the grounds and three motors employed to drive ventilating fans. The operating staff consists of F. K. Whitcher, the chief engineer, two assistant engineers, two oilers, three firemen and a coal passer. There is also a house electrician, who looks after the wiring.

All of the work is of excellent material and workmanship, and some of the fixtures are particularly graceful. The corner of the ladies' parlor selected for illustration, Fig. 3, shows three styles of artistic decorations of this character—a handsome electrolier, a four-light wall bracket and a pillar fixture representing a twining vine. The metal work is polished brass.

FIG. 1. LIGHTING EQUIPMENT OF THE CHICAGO BEACH HOTEL.—DYNAMO AND ENGINE ROOM.

American Institute of Electrical Engineers.

The eleventh annual meeting of the American Institute of Electrical Engineers is being held at Philadelphia this week. The principal features of the programme have already been published in this journal. Aside from the usual routine business, it is expected that action will be taken on several important subjects, including the disposition of a resolution favoring legalization of the units adopted at the Chicago electrical congress last year.

In view of the fact that the present meeting marks the completion of the tenth year of the Institute's existence, it is expected that there will be an unusually large attendance, and preparations on a more elaborate scale than heretofore have been made for social features. These

have been in the hands of a competent committee and include excursions, theater parties, tally-ho rides and an elaborate banquet. The list of papers has already been published and includes contributions from many prominent men. Those intrusted with the arrangements anticipate a very successful meeting.

Clinton E. Woods.

Clinton E. Woods, whose portrait accompanies this sketch, has become well known to electrical workers in the West during the last few years. Mr. Woods was born in Massachusetts in 1863, and at an early age was left an orphan and obliged to earn a living and acquire an education as best he might. In 1886 he drifted into steam and electrical work, being first identified with the local central station at Pittsfield, Mass.; afterward at Peekskill and Newburg, N. Y. From this he worked at general construction and engineering until 1889, when he entered the employment of the National Electric Manufacturing company, Eau Claire, Wis., as its inspecting engineer, and served in that capacity until 1892, when he was made

CLINTON E. WOODS

electrician-in-chief. This position he held until the spring of 1893, when he entered the Standard Electric company of Chicago. His work has won for him reputation and prominence in the electrical field. He has designed for this company a complete line of arc, alternating and constant potential dynamos, motors, etc., including such accessories as transformers and instruments for perfecting the system, during the last twelve months.

Mr. Woods is not only an electrician but a manufacturer, having advanced many improved methods of manufacturing dynamo-electric machinery, which have greatly enhanced the value of his work from an artistic and mechanical standpoint. From the knowledge and ability Mr. Woods has displayed and opportunity for results which are in his possession, much is looked for from his future work.

FIG. 2. LIGHTING EQUIPMENT OF THE CHICAGO BEACH HOTEL.—THE POWER HOUSE.

An Electric Road on a New Plan.

The most recent railway in Switzerland is an electric cable road up the mountain of Stanzhern, the apex of which, 1 900 meters above the level of the sea, forms an excellent summit from which to view the surrounding country and the lake of four cantons, which lies almost at its feet. Pilate and Righi peaks in the immediate vicinity, the former 2,123 meters and the latter 1,800 meters in height, are both better known to tourists, but the peak in question will now bid for favor in competition with its rivals.

Means of communication are ample. From Lucerne to Stanstadt a small steamboat conveys passengers at frequent intervals; an electric trolley road trip of 15 minutes spans the distance between the latter place and Stans, the point of departure of the road in question. The trolley line is fed from the same electrical source as the cable road.

The latter was opened in August of last year. The difference of level to overcome from the point named was 1,400 meters, and the length of the line, nearly 4,000 meters, would have been much greater had the road been made continuous, because of the tortuous windings of the track. To overcome these difficulties the road has been made to consist of three sections, passengers being twice transferred at intermediate points.

The first section, from Stans to Kælti lands, the passenger at a point 714 meters above sea level. The horizontal length of this track is 1,527 meters, and, including the grades, 1,550 meters; the grades range between 12 and 27.5 per cent.

The second section, from Kælti to Blumatt, climbs 507 meters farther in a horizontal distance of 960 meters, and, including grades, which range between 40 and 60 per cent., of 1 090 meters.

The third section, from Blumatt to the hotel at the end of the road, is 1,850 meters above the sea level. The length of the last stretch is horizontally 1,110 meters, and, including grades, which vary from 40 to 60 per cent., 1,275 meters. The road boasts of a tunnel 140 meters in length and a viaduct of about equal length, while its track is peculiarly wild and at times appears particularly hazard

FIG. 3. LIGHTING EQUIPMENT OF THE CHICAGO BEACH HOTEL.—FIXTURES IN LADIES' PARLOR.

ous. From the hotel a foot-path leads a winding way to the summit, which is 50 meters farther on. The sections have a single track with switch tracks at the half-way posts. Two cars move in opposite directions by the winding of the cable, actuated by a motor which revolves the drum. The three power houses are located at Kæ'ti, Blumatt and at the summit.

The motors receive their current from an hydraulic-electric station at Buochs, 5 kilometers distant from the road, where a waterfall in the river Aa furnishes power for the turbine wheels. As a precautionary measure, however, it is but just to state that engines of 60 horse power each are to be placed at each of the three terminals mentioned.

The compartments of the carriages are in the form of stairs. Each of these seats eight persons, which, with the outside or platform seats, makes a total of forty passengers per carriage.

The striking peculiarity of the Stanzhern railway is the entire absence of cog wheels. The brakes act, not upon toothed wheels, but on the rail direct. They are actuated by a powerful combination of screw and wheel, which is automatic in its action when the cable tension weakens. The system is a combination of the Croix-Rousse and the Heberlein methods. The rails are peculiarly formed to give better hold to the brake jaws.

At first sight it would seem the height of temerity to omit the cog work usually found on roads having so steep an ascent as 60 per cent., but the most rigorous tests made by the government technical experts have failed to show any cause for fear of the system. There are two pairs of brake clamps, each capable of a pressure of 13,500 kilogrammes, and a third pair actuated from the platform by hand for ordinary use.

The absence of the cog attachment is a notable economy, provided experience does not show in the future some more or less serious objection to its omission.

The time tables of the different sections are arranged so that there is little delay at the terminals and meeting points. Of course the speed is not uniform. It varies from 120 meters per minute to only 85 meters. The trip one way is made in forty-five minutes—a rate of 33 ⅓ feet perpendicular rise per minute, and the progressional speed is from 5 to 7 2 kilometers per hour. From Lucerne to the hotel the time is one and one-half hours.

Electric Launches on the Milwaukee River.

A number of Milwaukee business men have organized a company known as the Milwaukee Electric Launch company to operate a fleet of electric boats on the upper Milwaukee river. Open launches 35 feet long, equipped by the General Electric company and similar to those operated on the lagoons of the World's Fair last summer, will be employed. The current for charging will be obtained from the plant of the Milwaukee Street Railway company.

French Electric Locomotive.

A proposed form of electric locomotive for high speed passenger service is shown by the accompanying illustrations, which were made by the *Railroad Gazette* of New York from the designs of H. Bonneau, chief engineer of the Paris, Lyons and Mediterranean railroad, and E. Desroziers, the well known French electrician. A side elevation of the machine is shown in Fig. 1, and the *Gazette* gives the following description, in which the size of the locomotive and the proposed use of storage batteries are the remarkable features:

The locomotive has four driving wheels, a four-wheel leading truck and a two-wheel trailing truck, the drivers and trailing truck being so mounted as to form a rigid wheel base of 15 feet 7 inches supporting the frame by half elliptic springs. The springs of the trailing truck are placed above the boxes, while the driver springs are underhung and equalized. The leading truck is so mounted as to have a considerable range of lateral motion and is held normally in a central position by means of springs. In order to gain the necessary amount of space for the driving mechanism, the frames, which are of plate construction, are placed outside the drivers.

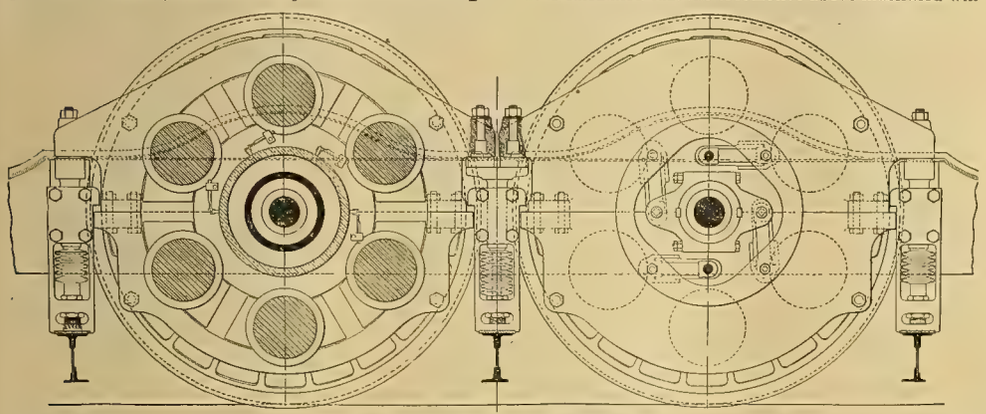


FIG. 2. FRENCH ELECTRIC LOCOMOTIVE.

The motors are slow-speed, six-pole machines of the Desroziers pattern, a motor being mounted on each axle. The armature shafts are hollow, their internal diameter being sufficient to give considerable clearance to the driving axles which they surround. The commutator of this motor is close to the armature and surrounded by the pole pieces. It is claimed that this construction permits the use of a more powerful motor than would otherwise be possible in the limited space between the drivers. The brusbes are easily reached, through the openings between the pole pieces. The field magnets are supported by heavy lugs on the motor frames bearing on vertical rods, the heads of which are so shaped as to permit a slight lateral motion of the motors. These rods are supported on U-shaped girders fastened at the upper ends to the frames, but are provided with buffers of Belleville washers in order that shocks may not be transmitted vertically from the frames to the motor. The motor is thus supported clear of the axle and transmits motion to the drivers through the system of drag links shown in Figs. 2 and 3. A double plate ring surrounds the axle and is connected to it by means of two short rods or links placed diametrically opposite to one another. Two similar rods perpendicular to the first connect this ring with the driver. In order to give this connection the greatest possible freedom of motion, ball bearings are provided at the ends of each rod.

Beneath the motors and secured to the U shaped girders is a casing of sheet iron and wood of sufficient length to protect both motors from dirt and moisture and carried up to the frame at the sides and ends. The upper part of the motor is left uncovered with the exception of the armature, which has a light iron casing.

A light cab covers the whole locomotive, thus completely protecting the motors and apparatus.

In order to avoid, if possible, the necessity of stringing conductors along the road, especially for branch lines, the company will at first experiment with storage batteries, and has made arrangements for carrying them over the leading truck of the locomotive. The necessary apparatus for controlling the supply of current and for the application of brakes is placed also at the front of the locomotive, where the engineer will have an unobstructed view of the track ahead.

The general dimensions and weights of this locomotive are as follows:

Driving wheel base	8 feet 6⅜ inches
Rigid wheel base	15 feet 7 inches
Length over buffers	37 feet 1⅞ inches
Diameter of drivers	7 feet 8½ inches
Diameter of trailing truck wheels	4 feet 7⅛ inches
Diameter of leading truck wheels	4 feet 1¼ inches
Weight on drivers	63,933 pounds
Weight on leading truck	28,660 pounds
Weight on trailing truck	44,092 pounds
Weight of frame and accessories	70,548 pounds
Weight of motors	55,115 pounds
Weight of apparatus	2 204 pounds
Weight of storage batteries	8 818 pounds
Total weight	136,685 pounds

It is calculated that the locomotive above illustrated will have a maximum power of 1,200 horse power. The first locomotive is to have a power of only about 300 horse power.

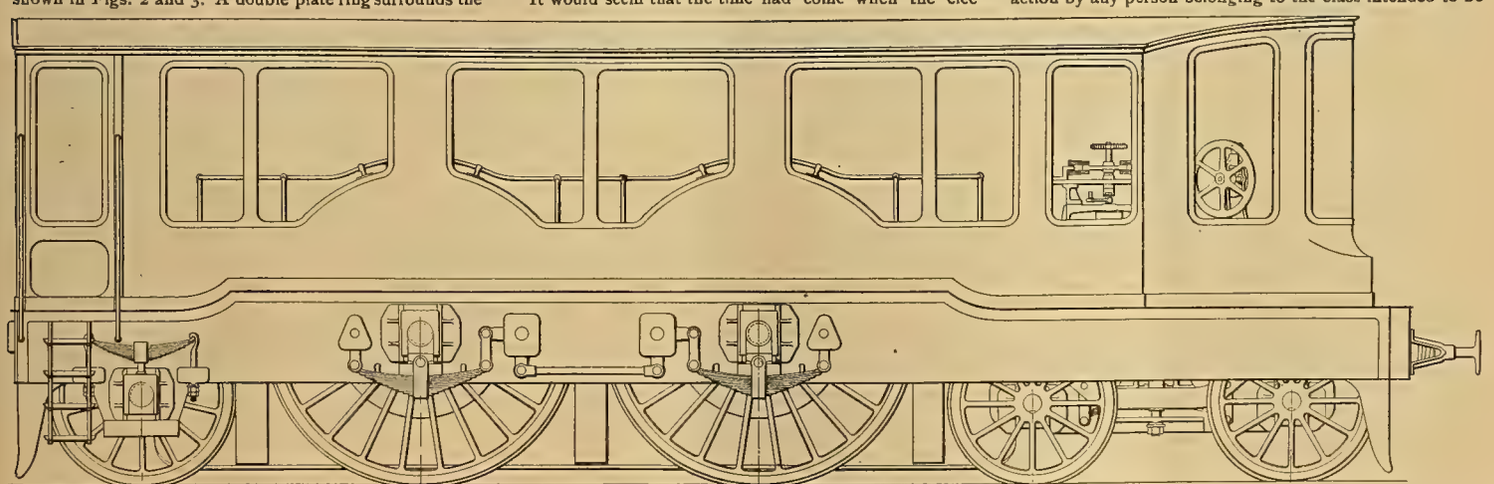


FIG. 1. FRENCH ELECTRIC LOCOMOTIVE.

Architects and Electricians.

The San Francisco chapter of the American Institute of Architects has appointed a special committee to examine and report on the question of appointing an electrical inspector, who, acting in conjunction with the underwriters, and under their rules, the fire marshal and fire department, would have entire charge of an electrical work coming from the architects' offices in that city. Further, it would be his business to draft all specifications for wiring, and design and superintend all electrical construction, but the architects in charge should have control in letting the work. In commenting on this plan the *Builder and Woodworker* of New York remarks:

It would seem that the time had come when the electrician should be acknowledged in his peculiar capacity as an expert, and allowed to take charge of all details relating to his work. This we understand, is favored by the best architects, so it cannot be long before a regular system will be adopted in all our principal cities.

It may be added that in Chicago all of the leading architects retain electrical engineers to lay out the wiring of new buildings. Several electrical engineers might be named who have each a large practice of this description.

The electric light plant at Freeport, Ill., was sold recently to a syndicate of eastern capitalists for $25,000. The light plant is to be consolidated with the electric street railway plant.

Rights and Duties of Electric Street Railways.

The Supreme Court of Nebraska holds, in the recently decided case of Omaha Street Railway company against Duvall (58 N.W. Rep., 531), that an instruction that if the motorman in charge of a street car could, in the exercise of reasonable care, have seen the driver of a horse ahead in time to have checked his car after the horse sprang upon the track, and before the car collided with the horse, and if the driver of the horse was not guilty of negligence which contributed to his injury, then the electric street railway company would be liable, was properly given, being qualified, as it was, by an immediately proceeding instruction that if the injury resulted from the sudden fright of the horse, by reason of which the horse sprang in front of the moving car, and if the motorman, in the exercise of reasonable care, could not have checked the car in time to have prevented the collision, the company would not be liable; these alternatives presenting, as they did, the only disputed propositions of fact involved. And as applied to the liability of street railway companies, whose cars are propelled by means of electricity, the following instruction was also held proper: "The violation of any statutory or valid municipal regulation established for the purpose of protecting persons or property from injury is of itself sufficient to prove such a breach of duty as will sustain a private action for negligence, if the other elements of actionable negligence concur. Thus, the violation of the statutes or ordinances regulating the speed of vehicles, horses or trains or street cars is such a breach of duty as may be made the foundation of an action by any person belonging to the class intended to be protected by such regulation, provided he is specially injured thereby." In the management of these powerful agencies, the court further says, there is a subserviency to the will of the agent in charge of the car, which, in the nature of things, could not exist when horses were the necessary means of propulsion. The public must depend almost entirely upon the watchful care of the motorman, and his absolute control of the machinery by which his car is impelled forward, as measuring the ability of these public vehicles to avoid the infliction of injury. There is great reason, therefore, for requiring the exercise of the utmost skill and watchfulness on the part of this agent, as well as of other employes of street railway companies,

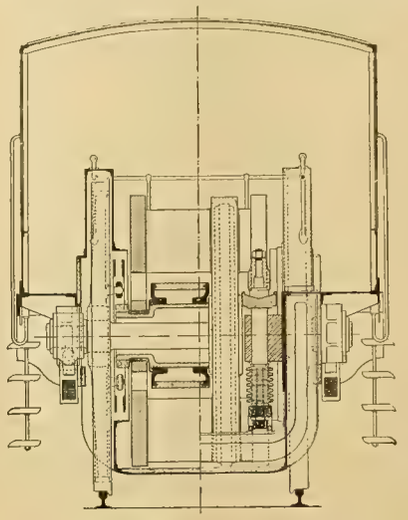


FIG. 3. FRENCH ELECTRIC LOCOMOTIVE.

to avoid collision with individuals equally entitled to the use of these public highways. The change noted in the methods of propulsion of street cars and the dangers incident thereto constitute a powerful argument for the strict application and enforcement of the principles which have been recognized as measuring the liability of street railway companies. Street railway companies have no such proprietary interest in that portion of the streets upon which their tracks are laid as limits the right of the general public, also, to use the same territory as a part of the public highway.

The Central Electric Company in its New Home.

There is something about the electrical supply business that surrounds it with greater interest than usually attaches to the hum-drum operations of trade. This is due largely, perhaps, to the fact that, despite all the vigorous denials of the infancy of the industry, there still remains, in the popular mind at least, much of the glamor of novelty surrounding electricity and electrical appliances, and also to the further circumstance that the business has grown to embrace such an extent of detail, with its imposing cloth-bound volumes of catalogues, that the mere size and diversity of it challenge admiration. But, although the industry is youthful, the manner of obtaining assured success in it is as old as human experience, and does not differ from that which is recognized as essential in other branches of business. Fair dealing, prudent management, enterprise and adaptability to changing conditions are as necessary for permanent success in the electrical supply business as in the hardware trade, for instance; there is no potency in the word "electricity" to change the laws of the commercial world. An example of the happy results attending an unvarying regard for this principle is shown by the steady growth of the Central Electric company, which, in face of the business depression of last year, was compelled to seek larger quarters for its increasing business, moving into the large building at 173 and 175 Adams street, Chicago, on May 1st. This building has been arranged for carrying on an extensive business in electrical supplies and is illustrated by the accompanying pictures.

The business of the Central Electric company was established in March, 1887, at 38 and 40 La Salle street, and George A. McKinlock, the present president, was connected with it from the start, being the first vice-president and treasurer. Mr. McKinlock has labored intelligently and well in the building up of the company to its present prominent position, and is widely known throughout the West. He was born in Oswego, N. Y., December 27, 1857, and he has been associated with electrical enterprises since 1877, when he was appointed manager and cashier of the American District Telegraph company at Detroit. A year later a telephone company was formed at Detroit and Mr. McKinlock was made cashier, being advanced in 1879 to the position of auditor. He was also connected with the Detroit Electrical Works, and when, in 1880, that concern was organized as a company, having previously existed as an agency of the Western Electric company, Mr. McKinlock was one of the incorporators. These interests the young man retained until 1887, when he determined to seek a wider business field. He accordingly resigned his position with the Michigan Telephone company, and with his brother, William H. McKinlock, came to Chicago and engaged in the electrical supply business, his brother becoming the secretary of the newly organized company. The company was fortunate in securing the western agency for the widely known Okonite wire, and it steadily grew and prospered. In May, 1888, the business had outgrown a single floor, and the building at 42 La Salle street was secured. This, with three stories and a basement, was thought to be sufficient, but in less than two years the necessities of increasing

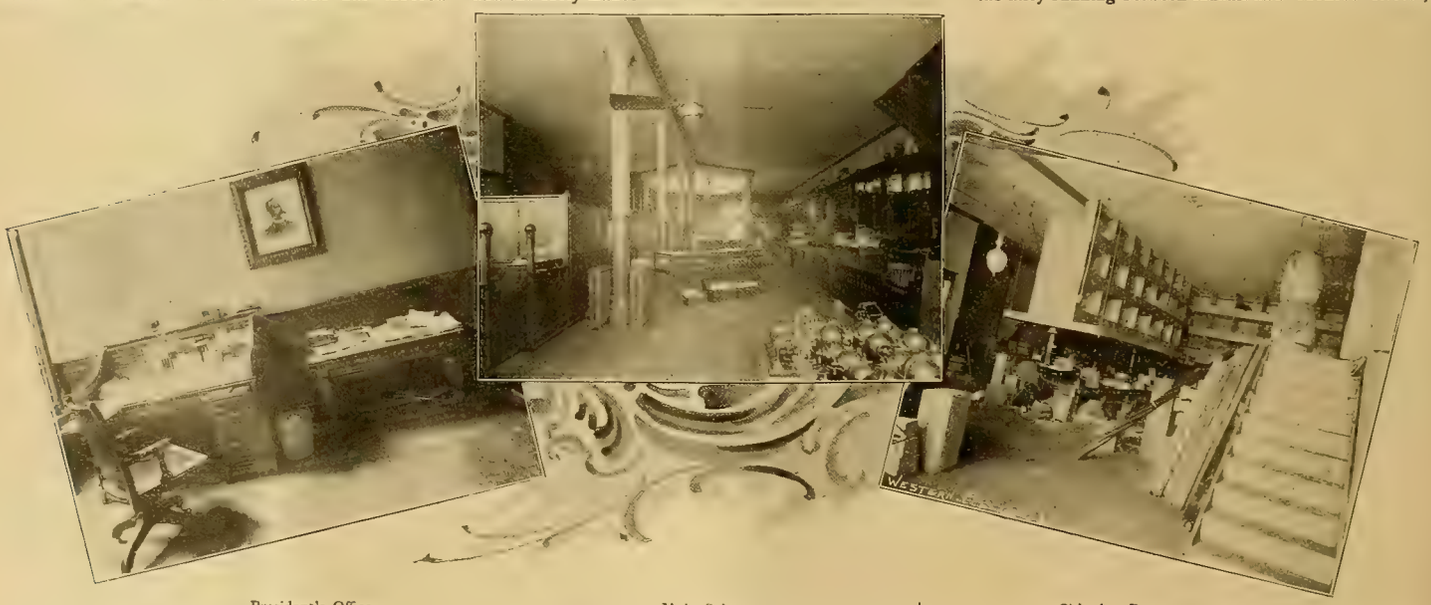
Geo. A. McKinlock, President. Chas. E. Brown, Secretary.
CENTRAL ELECTRIC COMPANY.

trade demanded larger quarters, and on January 1, 1890, the Central Electric company, now recognized as one of the leading supply houses of the West, moved into the building at 116 and 118 Franklin street—an address which has been a familiar one to the electrical fraternity for over four years. But last year it became evident that still better facilities for handling goods were needed, with the result that two floors and the basement of the exceptionally large and well located building at 173 and 175 Adams street, lately occupied by the General Electric company, were leased. During all this time Mr. McKinlock has devoted his time and energy to the company, with the exception of two European trips. The first, begun in the fall of 1890, signalized his marriage, and was of fourteen months' duration, the travelers visiting all parts of Europe, Egypt and the Holy Land.

The secretary of the company, Charles E. Brown, has been connected with it for six years, beginning as a salesman. Although barely 28 years of age, Mr. Brown has won recognition for decided business ability, coupled with energy and perseverance. He is a native of Philadelphia, a son of George F. Brown, general manager of Pullman's Palace Car company, and was formerly engaged with Marshall Field & Co. The heads of departments are as follows: Charles G. Burton, conduits; W. H. Huddleston, motors; W. R. Pinckard, house goods, and George W. Vernor, cashier. All told, the company employs about 60 men.

The policy of the company has been to offer to the trade only standard specialties of the highest grade. The business has been conducted on conservative lines, and its growth has been steady and healthy, not sporadic or by leaps and bounds. This fact is generally recognized, and in consequence the Central Electric company has an enviable reputation for solidity and stability. The company is general western agent for the Okonite products and for the Interior Conduit & Insulation company's goods, including the Lundell dynamos and motors. It also sells the Helios arc lamp for direct or alternating incandescent circuits and the new Pharos incandescent lamp. The latter is named after the famous ancient lighthouse at Alexandria and is manufactured especially for the Central Electric company. The company is also agent for the Washington Carbon company, and is making arrangements for a complete telephone outfit which it will be able to sell outright. At Columbia City, Ind., the company has its own factory for the manufacture of white oak cross-arms, brackets and insulator pins. Fifteen hands are here constantly employed. In addition to these goods the company handles all kinds of electrical supplies, including the "Banner" weatherproof wire and the Edison-Lalande batteries.

But little description need be added to the illustrations to give a general idea of the arrangement of the new establishment. An exterior view is given in Fig. 1. Passing through the main entrance of the store, the visitor is in the main salesroom, which is shown by the central picture in Fig. 2. This is a large, lofty apartment, with fine opportunity for attractive display. To the right of the entrance is arranged a number of fan and power motors, while farther on, attractively arranged in show cases and on shelves, is a varied assortment of measuring instruments, house goods, batteries, switches, shades, brass goods, tools—in fact, supplies and specialties of all sorts demanded by the retail trade. A sample switchboard panel, with large switches, is shown in this space, back of which is found a supply of magnet, annunciator, office, weatherproof and underwriters' wire, with fuse blocks and cut-outs. Of course only a small stock is carried on this floor, for the immediate filling of small orders. The stock in bulk is carried in the basement and on the second story, as may be judged from the glimpses in Fig. 3. The offices, as shown in Fig. 2, are at the left of the entrance. A separate view of the president's room is given. The rear of the ground floor is given up to a conveniently arranged shipping room, illustrated by the right-hand picture in Fig. 2. This opens on the alley running between Adams and Monroe streets, so that trucks may back up to the doors, and is connected by a large elevator with the upper and lower floors. One side of the room is arranged for receiving and the other for distributing freight. In this room, also, are the interior conduit supplies and most of the fittings. Adjoining it is a room for the display of fixtures.



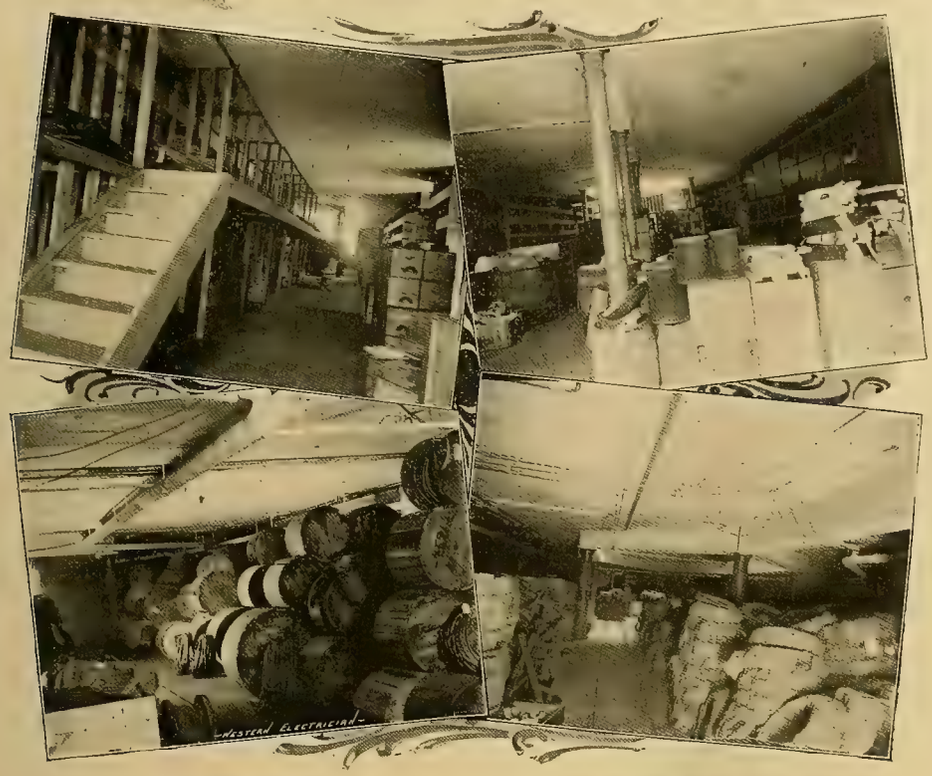
President's Office. Main Salesroom. Shipping Room.

FIG. 2. THE CENTRAL ELECTRIC COMPANY IN ITS NEW HOME.

Great coils and reels of wire, cords of cross-arms and brackets and thousands of compactly packed carbons confront the visitor in the basement. Many thousand pounds of copper conductors encased in Okonite insulation, in sizes ranging from No. 8 to No. 0000, are here stowed away, while there is also a large stock of Candee weatherproof wire, armored and lead cables and galvanized iron wire, with a great quantity of glass insulators. A

tramway is used for transporting the heavy articles on this floor, and the boiler room is located here. The entire building is lighted by electricity, of course, current being secured from the Adams street central station.

On the second floor there is a varied assortment of goods, including Okonite wire in sizes running from No. 7 to No. 24, insulating tape, lamp cord, arc and incandescent lamps, globes, nets and shades, battery cells and material, speaking tubes, motors, sockets, rosettes and porcelain goods, wiremen's tools, etc. These supplies are carefully classified and arranged in bins and wall-boxes, as shown in Fig. 3, so that orders may be correctly filled without delay. The stock is large and easily accessible and gives evidence of the tone of permanency and prosperity which pervades the whole establishment.



Wire bins, second floor. Heavy wire, basement. Lamp and other supplies, second floor. Basement view.

FIG. 3. THE CENTRAL ELECTRIC COMPANY IN ITS NEW HOME.

Arbitration for Conduit Privileges.

In Rochester, N. Y., the Rochester Gas & Electric Light company holds an exclusive franchise for a conduit for electric wires on East Main street. The Central Light & Power company, a rival concern, has petitioned the Common Council for permission to construct a conduit in that street, but the city attorney, when asked for an opinion, held that the only way that the Central company could bury its wires in that street would be to make an arrangement with the older company to use the existing conduit. The latter company is said to have asked an exorbitant price for the privilege, and now the city attorney has decided that, in accordance with a late law, the price to be paid for the use of the present conduit can be fixed by an arbitration committee, to be composed of one member of the lamp and electric committee of the Common Council, and a representative each from the Rochester Gas & Electric company and the Central Light & Power company.

Westinghouse Company's Annual Report.

The annual report of the Westinghouse Electric & Manufacturing company to the stockholders has just been issued, and the balance sheet, which is appended, shows that the company has prospered during the last twelve months in spite of the general depression in business. This report shows that the net profits from manufacturing and other sources amounted to $1,640,809.11, after deducting operating expenses, cost of alterations and additions to plant and the maintenance of machinery and tools. Special attention is directed to the influence of the World's Fair upon the business of the company, showing the wisdom of the policy pursued by the managers. The report says:

All of the apparatus used in connection with the World's Fair lighting contract and for exhibition purposes has now been returned to the warehouses of the company, and the final payments have been made by the World's Columbian Exposition company.

The amount of the contract for lighting was $399,000, and for extras under the contract $88,704.47, making the total received by the company $487,704.47. All goods shipped to the Fair were charged at the cost of labor and material with 20 per cent. added. After charging the account with all costs of every nature in connection with the running of the plant and of the exhibition, and crediting it upon the return of the material with the net cost of labor and material, it shows a net cost to the company of only $16,013.03 for a grand display of the company's apparatus, the advertising effect of which has been invaluable. The price at which the lighting apparatus used at the World's Fair and the apparatus used for exhibit has been sold will yield a handsome profit to the company.

It is gratifying to state in connection with this subject that the entire contract was carried out without friction of any character, and without a single deduction of any kind being made from the bills rendered by the company, and that the experience gained by the company in constructing such large apparatus was an important factor in the securing of the contract for the three 5,000 horse power generators now being constructed for the transmission of power from Niagara Falls for the Cataract Construction company.

The successful use at the World's Columbian Exposition of the stopper lamps manufactured by your company, and their large use in general lighting, have fortunately placed the company in a position to protect all of its customers from the aggressive action of the owners of the Edison patent covering the all-glass globe form of lamp. A steady advance has been made in the method of manufacture, so that your company is to-day producing a lamp which has no superior, and the use of which your officers expect to extend with great rapidity during the coming season on account of its quality and low cost of manufacture.

Following is the balance sheet, showing the condition of the company's finances at the close of its fiscal year, March 31st:

ASSETS.		
Cash in banks		$ 325,694 35
Bills receivable		373,445 51
Accounts receivable		2,345,161 20
Material in stock and in process of manufacture (at cost of labor and material)		1,545,472 22
Advances to leased companies		109,124 68
Bonds (par value $294,800)		237,397 15
Stocks (par value $6,489,490.16)		3,988,992 26
Real estate and buildings		464,403 48
Machinery and tools		886,452 67
Miscellaneous		66,339 07
Charters, franchises, patents, etc.		4,379,831 69
Total assets		$14,722,314 48
LIABILITIES.		
Accounts payable		$ 311,749 75
Bills payable, issued for merchandise		116,933 85
Discounted with collateral		697,300 00
Contract and Contingent Liabilities,		
Scrip dividend		$ 194,560 00
Stock subscriptions		13,125 00
U. S. E. Ltg. Co.'s 6 per cent. 15 year bonds, $50,000 payable annually		550,000 00
(Bills receivable under discount, $528,550.65)		
Capital Stock.		
Preferred, 73,439.31 shares	$3,671,965.50	
Assenting, 103,309.62 shares	5,165,481.00	
Common, 3,583 shares	179,150.00	
		9,016,596 50
(In treasury 6,560.69 shares preferred and 13,107.38 shares assenting.)		
SURPLUS.		
Balance, March 31, 1893	$2,757,694.19	
Twelve months' net earnings from business	$1,610,504.66	
From other sources	30,304.45	
	1,640,809.11	
	4,398,458.30	
Less amount written off in adjustment of matters pending in 1890 and 1891	19,198.78	
Ditto in current year	252,323.20	
	271,521.98	
	4,126,936.32	
Interest on bonds	36,000.00	
Interest on scrip	11,673.72	
Dividends	257,213.22	
	304,886.94	3,822,049 38
		$14,722,314 48

Intelligence has been received that, owing to the action of the Portuguese in obstructing the building of the telegraph line between the British sphere and Tete on the Zambesi, the commander of the British stern-wheel gunboat Mosquito landed a party at Tete and fired upon the Portuguese.

FIG. 1. THE CENTRAL ELECTRIC COMPANY IN ITS NEW HOME.—EXTERIOR VIEW.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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THE popularity of the trolley roads in Brooklyn must be a source of gratification to the street railway companies of the City of Churches. Better evidence of the superiority of the trolley over other methods of transit could not be had than the acknowledgment of the elevated roads that the competition of the trolley system was too sharp, and that it was found necessary by the L company to reduce expenses and really cripple the service.

THE scarcity of coal caused by the general strike of the miners has seriously affected many central stations in Illinois. Several have been compelled to resort to wood as fuel, while some have been obliged to shut down altogether. It is a curious condition of affairs—a forcible illustration of the defects of strikes as remedies for workingmen's grievances—that so many innocent and disinterested persons are made to suffer inconvenience and loss by a dispute in which they have no participation. A civilization in which such a state of affairs is possible is still far from perfect.

Now that the trolley has gained a foothold in Chicago the outlook for the extension of the system, so that it will cover all the outlying districts, is exceedingly bright. Additional franchises were granted by the city council to Mr. Yerkes last Monday evening and it is believed the ordinances will receive the mayor's approval. It seems to be agreed that until the opponents of the overhead trolley system have something to offer in its place that will give equally reliable and economical service they may as well withdraw their objections. The people want improved service and they recognize in the trolley system the only method of propulsion by which they can secure relief.

AN effort is being made in Milwaukee to compel the street railway company to charge only three cents for fare during the morning and early evening hours, when the working people are going to or returning from their places of employment. The company asserts, what is undoubtedly true, that it cannot afford to make the reduction. If the recent statements in relation to the financial condition of the company are true—and they may very well be as the result of the general business depression—it will be a great injustice to carry this measure through. We are inclined to think that the Milwaukee aldermen, after investigating the subject, will have the good sense to at least postpone this "reform" until more prosperous times.

MUCH activity is displayed in telephone circles at the present time, and there is promise of considerable competition especially in private line work and small exchanges in towns which could not afford the excessive rates heretofore exacted by the Bell company. In many of the smaller cities, too, where Bell exchanges have existed for several years new companies have been formed and franchises granted. It is a noticeable fact that many of the Bell company's exchanges in small cities are actively engaged in improving their service in anticipation of competition. All this naturally tends to the advantage of the public generally, and those engaged in telephone construction work cannot but be benefited by the activity in this department.

THERE is no doubt that much interest is felt in the meeting of the American Institute of Electrical Engineers at Philadelphia this week. Aside from the fact that this meeting marks the close of the tenth year of the society's existence, and that the event will be celebrated with unusual festivities, additional interest is lent to the occasion by the recent controversy over the rules governing elections and the general dissatisfaction expressed by members with the old administration. It is undoubtedly true that the Institute has reached a critical point in its career and that it will need a strong, conservative administration during the next twelve months to bring the organization safely through the controversies and contentions into which the last administration succeeded in involving the opposing factions.

It is to be regretted that the feeling of opposition should have reached the point where prominent members not in sympathy with the ruling faction determined not to attend the meeting. Every friend of the organization will deplore this condition of affairs. It should be an example to the incoming administration.

THE design for a high speed electric passenger locomotive presented on another page is of especial interest because it is proposed to experiment with storage batteries to furnish the energy to the motors. No details of the cells in contemplation are given, but it is said that they are to be placed on the leading truck of the locomotive, the weight being given as 8,818 pounds for a 1,200 horse power locomotive. This is but a little over seven pounds of storage battery material per horse power—an estimate that American electrical engineers will regard as ridiculously low. No details are given of the voltage of the motors or of the time of discharge, but, under the most favorable circumstances, it would seem that the batteries for a 1,200 horse power locomotive could not weigh less than 60,000 pounds, or 30 tons, which would still be a low estimate. Perhaps this weight would be considered an advantage, by securing additional traction, but it is an element that must certainly be reckoned upon. Possibly the French engineers have some wonderfully light secondary batteries in mind, but it would be interesting to know how they propose to get 1,200 horse power for only one hour, say, from 8,818 pounds of storage cells.

THE expiration of the Edison incandescent lamp patent in England has been followed by an era of cheap lamps—cheap not only in price, but in quality. Lamps that sold at 90 cents a piece were to be had as low as 14 cents—rather less than the lowest price yet reached for "non-infringing" lamps in this country. A large portion of this sudden influx of the London market came from foreign manufacturers, and the competition was carried to great lengths. Now, however, there appears to be a revulsion of feeling and the continental lamp manufacturers are considering the advisability of forming a union for mutual protection—to enable them to furnish good lamps at a fair margin of profit. The proposal has so far been accepted that an organizing committee of three influential lampmakers has been formed, and a general meeting is to be held on June 16th, in Berlin. It is not intended, according to the London *Electrical Review*, to attempt to secure the prices obtained by the monopoly—that is obviously out of the question—but it is hoped, by concerted action, to put a stop to the war of rates by agreeing upon a uniform price of something less than 24 cents. While this action looks suspiciously like the formation of a "trust", yet it may result in good, as it is of great importance to the electrical industry in general that the quality of incandescent lamps be not allowed to deteriorate. In purchasing a lamp from any reputable maker the customer should be assured that, at the rated voltage, the lamp will be of reasonably long life and of good efficiency. Otherwise he is apt to become resentful, and the whole electric lighting system falls under the ban of his suspicion. The consummation is one devoutly to be wished, but we fear that its accomplishment will be attended with great difficulty. There is little danger of a new and greater monopoly to succeed the old, and it is not, of course, impossible that some arrangement may be entered into which will enable the manufacturers to put out good lamps at moderate prices. At any rate, the movement will be watched with interest on this side of the water, where the incandescent lamp industry is just now in an anomalous condition. The American lamp patent will soon expire, and in the meantime the lessons bought by the experience of the European manufacturers will be carefully noted.

THERE are two bills before the present Congress providing for the governmental control of the telegraph business of the country. Last week the House committee, to which these bills were referred, gave a hearing to the advocates of the measures. Representatives of labor organizations appeared before the committee and urged favorable report. One of these labor leaders, speaking for the International Typographical Union, again presented the argument that, with the telegraph in the hands of the government, the rates could be greatly reduced, and this would make it possible to establish many newspapers in small towns throughout the country and give employment to many hundreds of printers. It was admitted that, at the rate proposed for this service, the telegraph would not be self-supporting, and a deficit would have to be provided for every year. This, of course, would mean additional taxation for the people, but Mr. Randall, the representative of the printers, did not think this should be considered. Samuel Gompers, another speaker, made the usual statements that the Western Union company was paying enormous dividends on watered stock, and that the telegraph should be made as cheap, proportionally, as the postal service. It was a noticeable fact that none of the advocates of the plan had any well-defined idea of the cost of construction and maintenance of an extensive telegraph system, nor were they prepared to say what system of toll should be adopted or what rate would meet the approval of the laboring men they were supposed to represent.

As a matter of fact there is a good deal of humbug about the movement. Politicians and labor agitators who are seeking a little cheap notoriety loudly denounce the telegraph "monopoly" because they realize that there exists considerable hard feeling toward the Western Union company among many of the old operators who remember the desastrous strike from which after ten years they have not yet fully recovered. But it is not to be expected that any considerable number of people will be mislead by the time-worn arguments presented by the gentlemen who visited Washington a week ago, nor is it to be expected either that the telegraph business of the country will pass under the control of the government in the near future.

Arnold's System of Electric Power Station Construction.

An electric power station in which are combined the advantages of the flexibility of the low speed or large engine belted plant with the low first cost of the directly connected or directly belted plant, has long been desired by central station managers. B. J. Arnold, of Chicago, claims to have perfected a system of power station construction embracing these features, the details of which are presented in the accompanying illustration. The advantages claimed for this system are as follows: Less cost per kilowatt of plant installed; less cost in operating expenses; less real estate occupied; absolute flexibility; less depreciation and greater ease in handling, than is usual in power plants heretofore installed. Referring to Figs. 1 and 3, engines No. 1 and No. 2 are cross compound condensing engines, having a rated capacity of 1,000 horse power each. Generators No. 1 and No. 2 have a rated capacity of 750 kilowatts each. The armatures of the generators are mounted upon hollow cast steel shafts or quills, *Cc*, running in independent bearings, *Pp*, so arranged that they are free to revolve independent of either engine, and of each other. Through these quills, and supported at its center by bearing *D* extends a steel or wrought iron shaft, carrying upon its ends circular cast steel or cast iron disks, *Ff*, securely keyed to the shaft. The drawing shows the engines connected to generators with magnetic clutches which operate as follows: Attached to the end of the engine shafts, *Aa*, are circular cast iron or cast steel disks:, *Hh*, carrying in recesses copper coils, *Oo*, which are connected to brushes, *Qq*, by means of rings, *Rr*, in such a manner as to permit a current of electricity to be passed through the

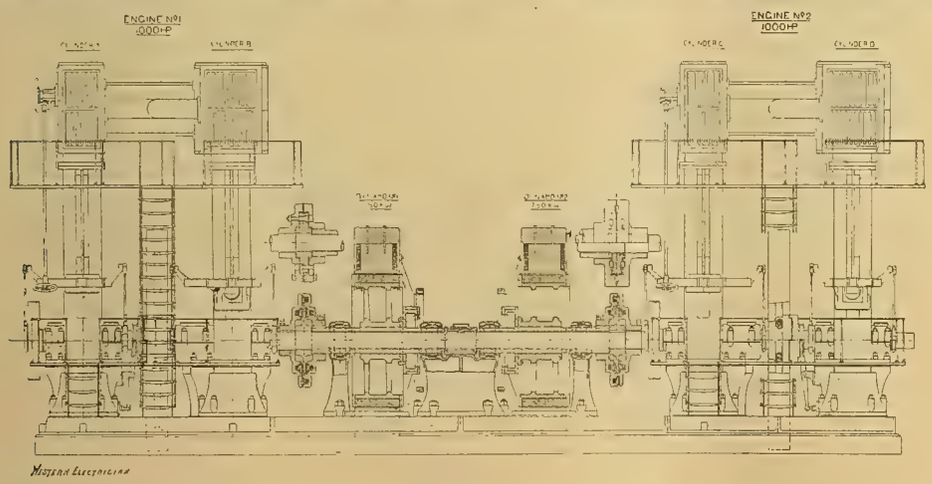


FIG 1. ARNOLD'S SYSTEM OF ELECTRIC POWER STATION CONSTRUCTION.

coils while the disks are in motion. Around the vertical face of disks, *Hh*, near the peripheries are carried cast steel or cast iron rings, *Ii*, which are held in position on disks, *Hh*, by means of three gudgeons or bolts, equally spaced around the periphery of disks, *Hh*. Rings *Ii*, are normally held against disks *Hh*, by small spiral springs surrounding the gudgeons or pins. Attached to quills *Cc* are cast iron or cast steel disks *Jj*, carrying two coils of copper wire *Mm*, *Nn*, which are connected to brushes *Kk*, so as to allow a current to be passed through the coils when the disks are in motion.

It will now be noticed that if a current of electricity is passed through the coil, *M*, a magnetic field will be created around it which will have a tendency to attract disk *I*, overcoming the action of the springs which normally hold it against disk, *H*, and clasping it securely to disk, *I*, so that power can be transmitted from one disk to the other by friction so long as the current travels through coil, *M*. If engine No. 1 now be set in motion it will drive generator No. 1 directly connected, there being no wearing parts except what are ordinarily encountered in a direct connected engine and dynamo plant. In a like manner engine No. 2 can be connected to generator No. 2, thus forming two direct connected power units.

Shaft *E* lies idle in bearing *D*, and is not used except in case it becomes necessary to drive either generator from the opposite engine, or both generators from the same engine. In an ordinary direct coupled plant with but two units of power, in case the engine of one unit and the generator of the other unit should become disabled, the plant would be at a standstill and unable to furnish any current at all. In such an emergency the system here described would operate as follows:

If engine No. 1 and generator No. 2 were the disabled portions of the plant, generator No. 1 would be driven from engine No. 2 as follows: Current would be passed through coil *o* thereby attracting disk *l* which would set shaft *E* in motion. Current would also be passed through coil *N* attracting disk *L* which would set the armature of generator No. 1 in motion. Current is then cut off from coil *M*, allowing the armature of generator No. 2 to come to rest. It will be readily understood that either generator can be reached from either engine in a like manner, thus making it practically interchangeable.

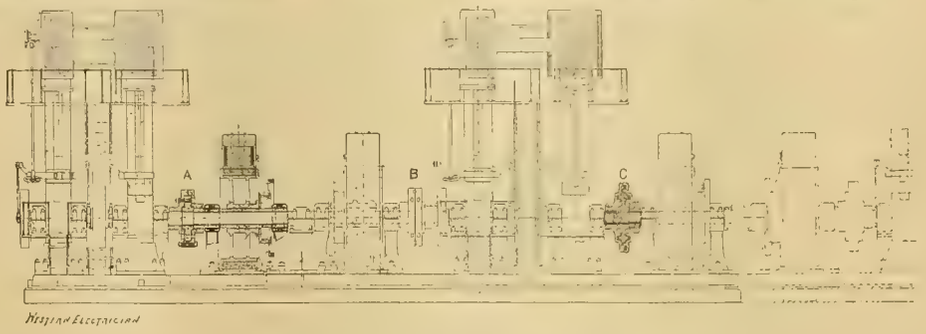


FIG. 6. ARNOLD'S SYSTEM OF ELECTRIC POWER STATION CONSTRUCTION.

Should one entire engine unit become disabled both generators can be driven from either engine by simply passing the current through the proper coils as follows:

If engine No. 2 were disabled, generator No. 1 would be driven direct from engine No. 1 by means of coils *M* and disk *I*, as alreaky described. Current would be passed through coil *N*, thus attracting disk *L* and setting *E* in motion. Current would then be passed through coil *n* attracting disk *g* thus setting disk *j* of generator No. 2 in motion.

It will thus be seen that either generator or both generators are available from either engine, and at the same time there is not the additional investment of a third engine and generator to be carried.

By having two engines with the high pressure cylinder of one, and the low pressure of the other directly connected to the work, the plant is arranged to operate economically with any load varying from 500 to 2,000 horse power, and it is practically impossible to shut down the plant on account of any accident that would be liable to happen.

It will be observed by reference to Fig. 1 that the main shaft of both engines is cut in the middle and the two parts joined together by means of positive jaw clutches, operated by steam cylinder. Thus when the load is light, say from midnight to morning on an elevated road, engine and generator No. 1 are shut down. Cylinder *D* of engine No. 2 is cut off by a jaw clutch, and no portion of the plant is operated except the high pressure cylinder of engine No. 2 directly coupled to generator No. 2. This cylinder can be run condensing and the plant operated with economy, until the road requires more power, when the low pressure cylinder is brought up to speed and connected with the high pressure cylinder without stopping the plant.

In case it becomes necessary to make repairs on the high pressure cylinder of engine No. 2 at the same time that the road is demanding full power of engine No. 1, high pressure steam may be admitted to the low pressure cylinder of engine No. 1, which as is shown in Fig. 1 is placed next to the generator. By working high pressure steam in the low pressure cylinder of this engine it will give its full power, thus driving its generator and allowing the high pressure side to be shut down for adjustment.

In order to prevent wear on the rings of the magnetic clutches already described, the following method of electrically starting the generators is covered under this system. Suppose engine No. 1 and its generator are operating and engine No. 2 and its generator are standing idle, and it becomes necessary to throw generator No. 2 upon engine No. 1, in order to repair something on generator No. 1. Instead of starting engine No. 2 to bring generator No. 2 up to speed, or allowing the friction of the magnetic clutch to bring the latter up to speed, the following method is adopted: Current being produced from generator No. 1 is passed through the armature and fields of generator No. 2 in such a manner as to make a motor of it until the armature attains the same speed as that of generator No. 1, when current is passed through coil *n* clamping disk *f* to disk *J* without wear on the clutch mechanism.

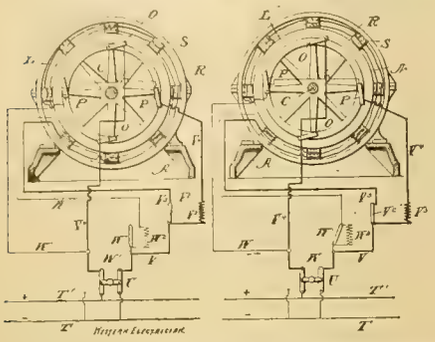
Figs. 4 and 5 are a diagrammatic representations of the circuits for operating the machines as motors and generators. Referring to Fig. 4, it may be assumed that it is a diagrammatic representation of generator No. 1 is running as a generator from engine No. 1. The circuit is as follows: From the positive bus-wire on the switchboard *T1*, through the double pole switch *U*, conductor *V4*, brushes *OO*, armature *L*, to brushes *PP*, to field magnet coils *SD*, conductor *V5*, switch *V2* and conductor *V*, to switch *U*, back to the other main conductor *T*. This machine is therefore supplying the main conductor with current. By disposing the parts as indicated in Fig. 5, the circuits will be varied so that the circuit of conductor *V* includes at first the high variable resistance *V3*, and excludes the series winding of the field magnet, and the shunt circuit excludes the resistance *W2* by means of switch *W1*, so a variable current may be made to pass through the armature by varying the resistance *V3*. Thus the machine operates as a shunt motor, and its sleeve shaft is driven at any desired rate of speed by simply adjusting the resistance *V3*. The rotation of the sleeve shaft will vary from the rotation of the main shaft, and when the armature of machine No. 2 has attained approximately the same speed as the shaft *E*, the magnetic clutch is thrown in circuit, the proper switches are thrown, and generator No. 2 ceases to be a motor, and becomes a generator capable of producing current.

FIG. 2. ARNOLD'S SYSTEM OF ELECTRIC POWER STATION CONSTRUCTION.

Should it become necessary to increase the capacity of

the power station designed under this system, it is done by adding two more generators to the right of engine No. 2, as shown in Fig. 6, having similar connections to generators Nos. 1 and 2, thus making four generators available from engine No. 2. The third engine is added as the power is required.

Figs. 3a and 3b show different forms of mechanical clutches which can be substituted for the magnetic clutches



FIGS. 4 AND 5. ARNOLD'S SYSTEM OF ELECTRIC POWER STATION CONSTRUCTION.

here described if necessary. In a railway plant the fact of having to stop the station for a few minutes at the time of changing from one engine to another is not so serious as in a lighting plant, and the mechanical clutches have been designed as substitutes for the magnetic clutches in case the conditions were such as not to warrant installing the magnetic clutches.

In Fig. 3a H is a disk securely keyed to engine shaft A of engine No. 1; J is a circular disk securely keyed to quill C of generator No. 1; F is a circular disk keyed to the common shaft E. If it is desired to drive generator No. 1, three bolts, T, spaced equi-distant on the circumference, are used to bolt disks H and J rigidly together, the same as cable railway plants are operated. Engine No. 1 is thus driving generator No. 1 directly connected without any wearing parts except the bearings of the two machines. In case it becomes necessary to drive generator No. 2 from engine No. 2, bolts S are inserted as shown, thus rigidly connecting disk H to disk F and revolving shaft E. Bolts S can be reversed so that disk F will be rigidly fastened to disk J, permitting shaft E to drive generator No. 1 from engine No. 2, thus performing all the functions of the magnetic clutch.

Fig. 3b is another form of clutch now commonly used in cable railway plants. Disks H and J are keyed to the engine and generator shafts respectively and disk X is keyed to shaft E. If it is desired to drive generator No. 2 from engine No. 2, two steel or wrought iron keys are inserted in recesses UU, thus rigidly connecting the disk H to disk J.

By inserting the wedges in recesses VV shaft E is made to revolve from engine No. 2 and by inserting the wedges in recesses WW generator No. 2 is caused to revolve from shaft E, thus making the plant interchangeable in all directions.

The entire plant is mounted upon cast-iron bed-plate construction, cast in sections and thoroughly anchored, the same as first class cable railway power construction of the present day.

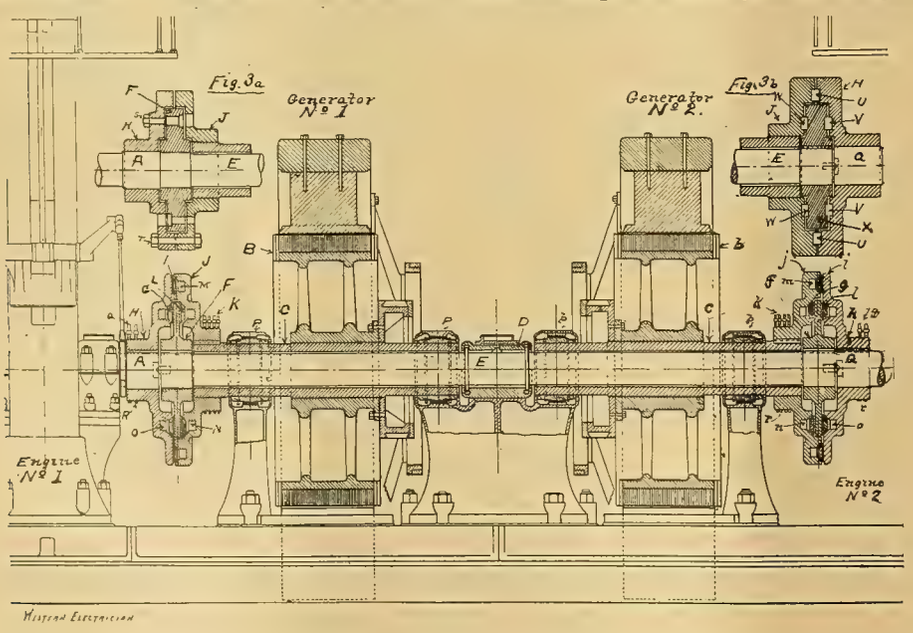
The system is applicable to lighting stations where a large number of small electrical units must be used,

Fig. 3 shows a 1,000 horse power combined incandescent and arc light station. At each end of the line shaft is placed a high speed engine directly connected to the shaft. The shaft being detachable from each engine, parting at its center, so that either portion of the shaft can be shut down in case of a hot journal, while the other portion of the plant remains in running order. The generators are mounted on quills, carried in independent bearings, and motion is transmitted to the generator by means of positive jaw clutches. It will thus be noticed that when the generator is not running there is absolutely no wear upon the shaft, no side strain by the pulling of belts, or no friction clutch pulleys to get out of adjustment. The strain on the shafting is purely torsional, thus permitting it to be small in diameter and making it much less liable to get out of alignment.

When it is desired to start any generator, it is brought up to speed as a motor, and when it attains the same speed as the line shaft, a positive clutch, operated either by hand or by electricity, is thrown into connection, after which the current is reversed through the machine and it immediately becomes a generator.

It will thus be noticed that any generator in the plant can be started and stopped at will, without stopping either engine, or without using belts, pulleys or friction clutches, thus having all the flexibility and reliability of the ordinary low speed lighting station, wherein shafting and belting are used, and occupying not over one-quarter the amount of real estate that such a plant ordinarily covers. This permits a very much less expensive building to be constructed, less investment in real estate, greater ease in operation on account of having fewer wearing parts to lubricate, and less labor to operate the plant.

Another important feature of the system is the fact that any standard make of dynamos and engines can be utilized, thus necessitating no radical departure from the present lines of manufacture. For this reason many of the present plants can be rebuilt to conform to this system and utilize a large part of their old equipment.



FIGS. 3, 3a AND 3b. ARNOLD'S SYSTEM OF ELECTRIC POWER STATION CONSTRUCTION.

The Canandaigua Electric Light company has installed a 1,500 light incandescent machine at Shortsville, N. Y.

Link Belt Machinery.

The Link Belt Machinery company, Chicago, has just completed a jack shaft for the American Axe & Tool company, Beaver Falls, Pa., which is shown in Fig. 1. The shaft is 33 feet 8 inches long, and 7 15-16 inches in diameter. The sizes of the sheaves are respec ively as follows: A 48 inch 6 groove sheave for 1 1-4 inch rope with a 42 inch four-arm Ewart guaranteed friction clutch; a 72 inch 4-groove sheave for 1 1-8 inch rope with a 14 inch square jaw clutch; a 54 inch 12-groove sheave for 1 3-8 inch rope with a 14 inch square jaw clutch; a 54 inch 33-groove sheave for 1 3-8 inch rope, made in two parts, and a 54 inch 8-groove sheave for 1 1-4 inch rope. The size of the 54 inch sheave may better be appreciated by reference to Fig. 2. The bearings are all ball and socket pillow blocks having 24 inch bearings, except one on the end which has 18 inches. The Link Belt Manufacturing company has just furnished the Northwestern Yeast company one of its standard water tube boilers, which goes into this company's new Chicago factory. It is also erecting for the Chicago Sugar Refining company, West Taylor street, a conveyer which will take 700 pound barrels of glucose from the refinery to the river dock and load into a vessel, a distance of 435 feet.

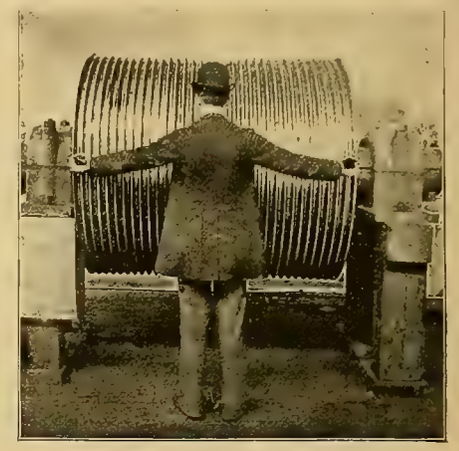


FIG. 2. LINK BELT MACHINERY.

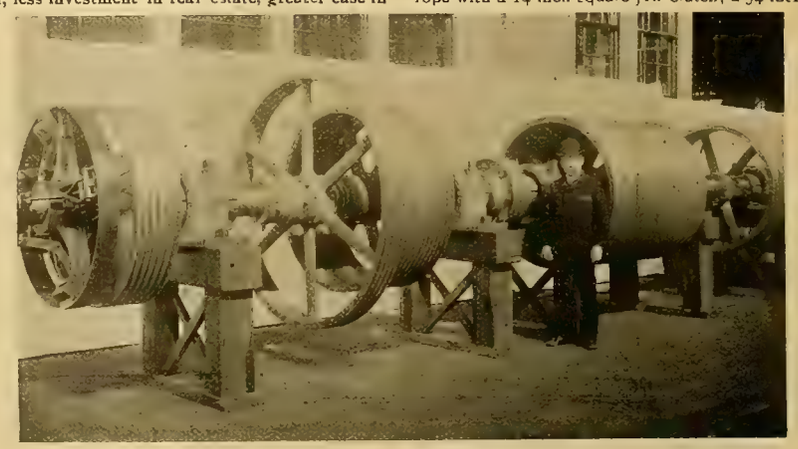


FIG. 1. LINK BELT MACHINERY.

Improvement in Pipe Cutters.

In the accompanying cut is shown an improved form of pipe cutters manufactured by Curtis & Curtis, Bridgeport, Conn. The general principle is the same as in all other three-wheel cutters, except that this has an exceedingly simple and quick adjustment which will save much time to the operator. Instead of having the screw run through the body of the cutter, it is run through a sleeve, which in turn slides in the body and is held by a spring-pawl. Thus, in operating, the delay occasioned by adjusting the cutter to the size of pipe to be cut is avoided by simply sliding the sleeve until the wheel is against the pipe, when a few turns of the screw, while the cutter is revolved, cuts it off.

IMPROVEMENT IN PIPE CUTTERS.

It is said that a synd cate of New York, Chicago, Boston, St. Louis and New Orleans men has been formed to exploit the conduit trolley railway system of Granville T. Woods, the co'ored inventor.

New Vulca Bushings.

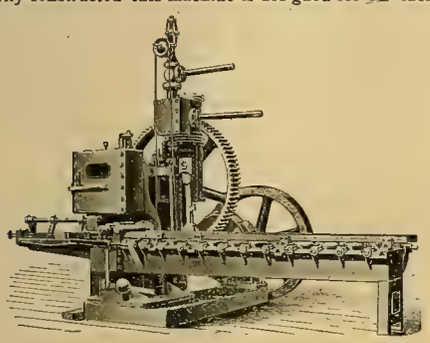
The new Vulca bushings of the New York Insulated Wire company have been perfected and are now on the market. The accompanying cut shows the general appearance of these bushings. They are made in several sizes, ranging from 5-19 to ¾ inch in inside diameter and 6 to 12 inches outside lengths. These bushings, it is

NEW VULCA BUSHINGS.

claimed, are moisture-proof, non-inflammable and are not affected by the action of Portland or hydraulic cements. They have been approved by the National Board of Fire Underwriters and the Chicago fire department.

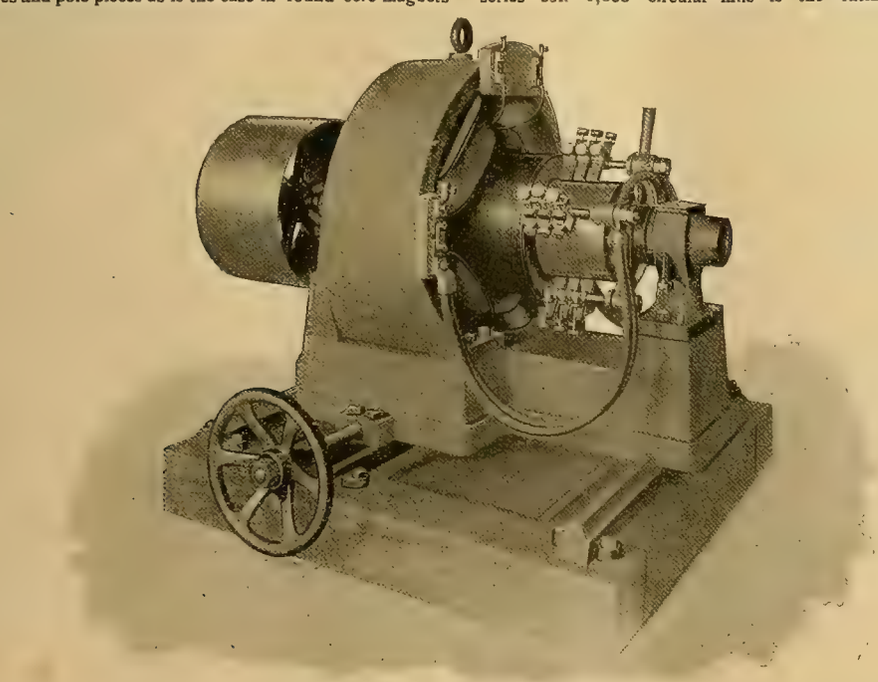
New Riker Multipolar Dynamo.

The dynamo shown in the accompanying cut has just been placed upon the market by the Riker Electric Motor company, 45-47 York street, Brooklyn, N. Y. As ordinarily constructed this machine is designed for an incan-



AUTOMATIC MUCK BAR SHEAR.

descent generator working at the standard pressure of 125 volts. The base is made of cast-iron, very heavy and thoroughly braced to prevent the springing of the bearings. The field magnet is built of cast-steel, with salient poles projecting radially inward. In sizes up to and including 20 kilowatt high speed and 6 kilowatt low speed the field is cast in one piece, while in larger sizes the field is split to facilitate the handling of the armature. The section of the poles in all machines of this type is square, thus permitting a minimum length of wire to surround a maximum section of iron without the necessity of making separate cores and pole pieces as is the case in round core magnets



NEW RIKER MULTIPOLAR DYNAMO.

of this general description. The field coils are wound on heavy metallic thimbles or spools, which serve the double purpose of holding the coils securely in place and, by their action as closed secondaries, absorbing the destructive induction sparks that result from breaking the field circuit.

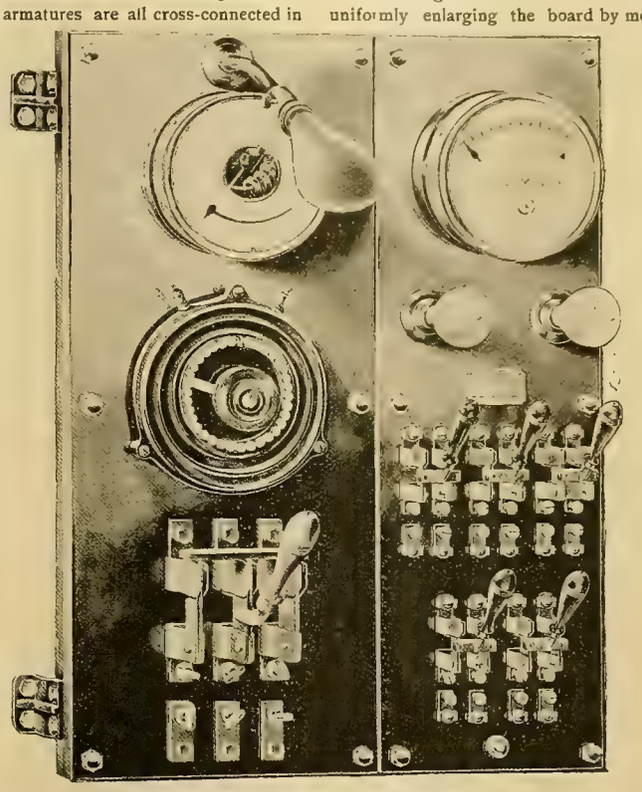
All these generators are compound wound to maintain practically a constant potential, a slight rise of one or two per cent. being allowed to compensate for a fall in engine speed.

The armature is of the drum type, the plates being mounted directly and keyed fast to the shaft. The plates are clamped between heavy cast iron flanges which are threaded on the shaft. No bolts pass through the core plates, thus obviating the trouble and expense of extensive insulation in the armature. The wires are laid in milled grooves, and all insulation on the armature between the core and the wire is either micanite cloth or pure mica. The coils of these armatures are all cross-connected in parallel grouping, in order that the electrical balance shall be maintained even when one or two sets of brushes are removed. The commutator is heavily built, the bars being clamped between steel cones and insulated throughout with mica.

A rating of 500 circular mils per ampere at full load is allowed in all armatures, while in the shunt and series coil 1,000 circular mils is the rating. The company is prepared to furnish this type of machine in sizes from 10 to 100 kilowatts.

Switchboard for Isolated Plants.

The accompanying cut shows an improved form of switchboard for isolated plants recently brought out by the General Electric company. The complete board comprises a panel for each generator and one for each set of five feeders. The generator panel is equipped with newly designed switches of high conductivity and durability, each of which has its own fuse holder. The rheostat and ampere meter are of the latest and most compact type. Each feeder panel carries an improved voltmeter and two-lamp ground detector, the push button being shown in the lower part of the panel. An advantage of this arrangement of switchboard is the possibility of uniformly enlarging the board by merely adding panels.



SWITCHBOARD FOR ISOLATED PLANTS.

They can be set side by side and be connected with tie bars.

Automatic Muck Bar Shear.

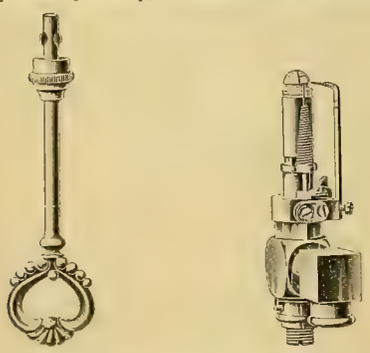
In the process of rolling steel into thin sheets, it has been found impracticable to roll each sheet separately as it would not retain its heat, and the following method is adopted: A billet of steel of sufficient size to make a large number of sheets is heated and passed a number of times through a train of rolls, lengthening the bar and reducing its size. It leaves these rolls in the form of a bar twenty or thirty feet long and about an inch thick by eight inches wide, these dimensions depending upon the size and gauge of the sheets to be made. These bars, technically known as the muck bars, are cut up into uniform lengths, and each piece is then repeatedly re-rolled and folded over, each rolling operation reducing the thickness and increasing the linear dimensions; and each folding doubling the number of sheets in the final pack. After the last rolling the ends of the pack are sheared, leaving each sheet free to be separated. It is very important that the pieces into which the muck bar is cut should be of uniform size, and squarely cut, as upon this depends the size and form of the subsequent pack, and it will easily be seen that any error will be largely exaggerated with the successive passes through the rolls. The method heretofore employed for shearing the muck bar has been to carry the bar to the old-fashioned alligator shear, place the end against a fixed gauge, which determined the length of the pieces, and pass the bar along by hand for the successive cuts. This method required several men to handle the bar, and considerable skill on the part of the shearman. The illustration herewith presented shows a machine designed by the E. W. Bliss company, 14 John street, Brooklyn, for doing this work automatically, thus requiring but one man to the work, who need not be a skilled shearman. The machine consists of a powerful gate shear driven directly by an engine. A clutch is attached to the engine shaft which can be operated either by hand or automatically. To the right of the machine is a carrier composed of a train of rolls driven continuously. The muck bar coming hot from the rolls is placed upon these carriers, which propel it toward the cutters between side gauges to keep it in position at right angles to the shear blades. Just before entering between the cutters a pair of feed rolls takes hold of the bar so as to feed it positively. A clamping device is placed in the path of the bar and so arranged with

a lever that the progress of the bar may be arrested by the operator. This lever also controls the feed rolls so that when the clamps are in contact with the bar, the rolls are removed from it and vice versa. This arrangement gives the operator full control over the bar, and he is enabled to bring it into proper position to square off the ragged end, by throwing the clutch into operation by means of the hand lever shown in cut at the front of the cutter housing. When the forward end of the bar has been squared the operator raises the clamp lever, and the bar feeds forward. An adjustable gauge is placed in its path, and upon striking this its progress is arrested and the clutch is automatically thrown into operation, causing the upper shear blade to descend and cut off the first length. As soon as this occurs the piece drops out, the shear blade ascends to its upper position and stops, while the bar again feeds forward and the operation is repeated until the bar is all cut to lengths. By this system the bars are cut accurately and as rapidly as they come from the rolls.

In order to adapt the machine to the practical requirements of mill work, experiments were conducted for some time by the makers at the mills of the Canonsburgh Iron & Steel company, and this machine is the outcome of these experiments.

New Era Electric Gas Lighter.

The New Era electric gas lighter, manufactured by the American Electric company of Boston, which was received with so much favor when it was introduced two years ago, has been greatly improved, and is now as far superior to the old form as that was in advance of primitive methods. It is operated by the key, which indicates whether the gas

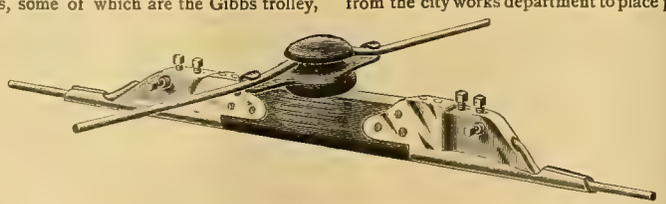


NEW ERA ELECTRIC GAS LIGHTER.

is turned on or off. By turning on the key for full head of gas this operation also lights it. When the key is turned back as far as it will go, the gas is securely shut off. The flame may be reduced or increased at will by the key. By an ingenious device, the singing noise so annoying to nervous people is obviated in this burner. The company is now making the device with interchangeable stems, so that in a half minute's time a longer or shorter stem can be applied. By removing the stem before putting the burner on the fixture, the elbow need not be disturbed as formerly. This is a decided improvement. The new method of attaching both the electrodes will be appreciated, as by this method, it is claimed, the burner can never get out of adjustment. The company announces that the improvements in this device have been thoroughly tested, and in every case have proved satisfactory in every respect.

Metropolitan Specialties.

The Metropolitan Electric company, Chicago, is about to enter the street railway field, and has already secured a few good specialties, some of which are the Gibbs trolley,



METROPOLITAN SPECIALTIES.

Knox circuit breaker, the Chicago trolley clamp, and the Paulsen rail bond caps. Strength, durability and ease in applying is claimed for the Knox trolley line circuit breaker. The wearing parts of this breaker, which is shown in the accompanying illustration, are so constructed as to enable the company to offer it as a most durable trolley line circuit breaker. It has a tensile strength of more than double that of the trolley wire, and can be placed in the line in less than 15 minutes. It is indestructible, and offers the highest possible resistance to the leakage of current across its insulating parts. It does not get out of order, and affords the easy passage of trolley wheel over the parts, which is lacking in other forms of circuit breakers. The set screws on the sides of the brasses are for a fuse, should it be desirable to fuse from one section of line to another.

"Circulation is What Counts."

[From *Rubier's Popular Electrician.*]

The *Electrical World* in it issue of April 7th takes occasion to show by some comparison of figures that although the WESTERN ELECTRICIAN on March 31, reached a circulation of 16,630 copies, whereas the *Electrical World* printed 15,500, the *World* contained more advertisements and more pages than the ELECTRICIAN. Brother Johnston must have time wasting on his hands to devote so much of it to making these fine comparisons. Or perhaps he feels as though our western neighbor had outdone him. In fact, according to our opinion, he acknowledges as much with very bad grace.

The fact that a journal does not contain as many advertisements as another cannot depreciate its value as an advertising medium; in our opinion it rather enhances it. One of the best advertising mediums in the United States, the *Youth's Companion*, hardly ever devotes over six or eight pages to advertisements. It certainly looks to us as though the "pioneer journal" was losing its rank as having the largest circulation of any electrical paper. Get a move on, brother, or our western contemporary will leave you behind. Remember, circulation is what counts, not amount of paper and numbers of advertisements.

Practical Instruction in Electricity.

A Chicago organization known as the Association of Practical Electricians has been chartered with these officers: President, G. Sanford; vice-president, George H. Jacob; treasurer, H. C. Lamb; recording secretary, John L. Hagedon; financial secretary, George Ferrar. The board of directors consists of the above named officers and John McCosh, J. H. Wilson and Frank P. Butz. It is intended to establish a school for wiremen and other electrical workers, giving instruction in practical work principally, but not neglecting the theory of electrical phenomena. The president says: "We expect to secure a competent corps of instructors and to have occasional lectures from celebrated men in electrical work. Members will enter at the lowest grade and pass upward the same as in a college, if their efficiency meets the approval of a board of examiners, which will be made up of college professors and scientists. At the end of the course graduates will be given a diploma certifying to their acquirements. The men who will attend this school are all workmen, employed during the day, so necessarily the instruction will be at night. It is not our idea to attempt to turn out electrical engineers, but simply to train men who are workers to a better knowledge of their work. We believe that the diploma of a graduate will be a guarantee to his employers and the public that he is a competent man."

CORRESPONDENCE.

New York Notes.

NEW YORK, May 14.—On Tuesday night two park policemen of Brooklyn attempted to prevent employes of the Brooklyn Heights Railroad company from erecting trolley poles on Ocean avenue, and a fight ensued, in which the police were roughly handled. This temporary victory, however, did not help the company, for it provoked a storm of censure from prominent citizens and city officials. Mayor Schieren was very indignant when the news of the encounter reached him and he denounced the corporation for its "high-handed policy." The Brooklyn Heights Railroad company obtained a permit from the city works department to place poles on the avenue. Commissioner White acted in accordance with a revision of the law of 1889, which exempted Ocean avenue from trolley cars, but in 1892 the law was modified. The company then asked for a permit from Park Commissioner Squier, who refused to grant one, but Commissioner White granted it, and this Commissioner Squier asked Mr. White to recall. He replied that it could not be recalled, but President Lewis was asked not to proceed with the work at present. Mr. Lewis refused to comply with this request, but ordered the men to go on with the work of erecting the poles. Mr. Squier heard of this and notified the park police to stop the work. It was this order of the commissioner that caused the police to interfere on Tuesday night.

Later a conference of city officials and representatives of the railway company was held, but the question will have to be decided by the courts. Mayor Schieren said: "On general principles I am in favor of the trolley, because it is an advance over the old method of travel on surface lines, bnt I will not permit the trolley lines to seize the highways without notice or permission. The people have rights which must be respected and preserved at all hazards."

Brooklyn bridge cars may be lighted electrically before long, as experiments are now being made with a system developed by Lieut. I. N. Lewis, in which a dynamo driven by the car axle and storage batteries are employed. A test made last week proved highly satisfactory and further experiments will be made in this line.

The Edison Electric Light company has brought a suit in the United States Circuit Court against the Westinghouse Electric Light company for alleged violation of patents granted in 1882 for the distribution of electricity. The Edison company claims royalties for the electric lights used at the World's Fair. The Westinghouse Electric Light company has filed an answer, in which it is claimed that Edison had no right to the patent sued on, on the ground that the principle applied was old and well known, and was not his invention. W. F. O.

Milwaukee, Wis.

MILWAUKEE, Wis., May 12.—The electric railway franchise fight at Oshkosh has been settled. At a meeting of the Common Council it was unanimously decided to grant a franchise to J. K. Tillotson, under conditions that the old company refused two years ago. Mr. Tillotson declares that he will have electric cars running within seven months. He announces his intention of beginning work in three or four weeks, and reiterates his intention of building an inter-urban electric line from Oshkosh to Kaukauna. O. L. Huie, superintendent of the Neenah and Menasha line, says that he has had the project of an inter-urban line between Neenah and Kaukauna under consideration for about four years, and that, although he has been negotiating with Tillotson for some time with a view of extending the line to Oshkosh, he would prefer to have the Oshkosh end of the enterprise dropped. Still, he says, he and Tillotson together have secured 90 per cent. of the right-of-way between Oshkosh and Kaukauna. He declares that a line from Neenah to Kaukauna is an absolute certainty, no matter what may become of the Oshkosh end of the project. Offers of water power at three different points on the line have been made, and it is estimated that the line could be operated at a very small cost, comparatively speaking. One steam power house would be needed if the line were built to Oshkosh.

The Oshkosh Electric Light & Power company will probably be reorganized. All the creditors of the company except the Russell Manufacturing company of Massilon, O., have agreed to the plan, and that company is not expected to hold out.

The Wisconsin Automatic Telephone company has begun work at Appleton. Twelve telephones, the number required to hold the franchise in that city, have been placed in the plant of the Paine Lumber company.

The electric line between Onalaska and La Crosse is nearly completed, and cars will probably be running by June 1st.

It is said that the affairs of the Fond du Lac Light, Power & Railway company are being straightened out, and that the danger of going into the hands of a receiver is now very slight. The Great Western Manufacturing company of Chicago and Duluth will furnish the company all necessary material. There are five liens against the company, the claims aggregating about $4,000, and in addition the company owes large bills to the city and the Fond du Lac Water company.

The electric light plant at South Milwaukee has been purchased by W. M. Williams, a director of the old company, and he is operating it. He has agreed to reduce the price of arc lights to the village to $85 a year if the village will enter into a contract for twenty-five of them. There are only about half that number in use at the present time.

The Wauwatosa electric line begins at Twenty-seventh street, and the Milwaukee Street Railway company's line ends at that point. The Milwaukee company operates the Wauwatosa line, but when the cars reach Twenty-seventh street, going in either direction, all the passengers have to pay a second time. People who live just beyond Twenty-seventh street do not like to walk the extra distance, nor do they like to pay a second fare for the privilege of riding. The street railway people won't yield the

point, and the people interested may appeal to the Common Council to interfere in the matter.

Edward Moeller has been appointed receiver of the Wisconsin Dynamo company. The company is a small concern and the receiver's bond is only $2,500.

The National Telephone Construction company has filed articles of incorporation. The capital stock of the company is $150,000 and the incorporators are John Westervelt, Orson E. Hubbard and Frank H. Brice. It is said that the company will build exchanges in the smaller towns of the state.

The trouble between the city and the Milwaukee Arc Light company has been settled. The company has removed the overhead wires which it strung in violation of the city ordinance, thus saving the Board of Public Works the job of having the wires cut down on its responsibility.

If the strike at the coal mines lasts much longer, it is quite probable that the electric cars of the city will have to give way to horse and mule power, as the supply of coal is getting low. About two weeks ago, in apprehension of trouble, the street railway company contracted with a local coal firm for 20,000 tons of coal, but the firm cannot fill the order, and although the street railway is protected against loss by reason of its contract, its coal bins are nevertheless apt to become empty. All users of coal for power purposes are becoming exceedingly anxious.

The Milwaukee Street Railway company announces that it will build no extensions to its system unless it receives a bonus in each and every case. The idea of building to St. Francis and Cudahy this year has been abandoned. General Manager Wyman has examined the proposed lines and he says that it would be foolhardy to talk of building them for some time to come.

In the whole world there are few larger electric railway systems, or other street railway systems for that matter, under one management than there are in Milwaukee. According to General Manager Wyman, the distance traveled by all the cars of the Milwaukee system in one day is equal to three trips from Milwaukee to London and return, with several miles to spare. The cars travel upward of 20,000 miles a day, and in the course of a year they travel between 7,000,000 and 8,000,000 miles. They travel the distance around the world something like 300, times in one year. The number of miles of track is 125.

At present the street railway company pays taxes on about $1,000,000 worth of property. The company's property is said to be worth at least $5,000,000, and a movement is on foot to compel it to pay more taxes. The tax commissioner has asked the city attorney whether, instead of assessing the company's property in each ward, he cannot assess it in the aggregate, so as to include the tracks, in addition to the real estate and buildings.

A short time ago Manager Wyman issued an order prohibiting employes from sitting down while on duty. A conductor on a South Side line violated the rule and he was at once discharged. Some of the other conductors have taken up the matter and declare that they will take the fight against the rule into the union. They declare that the rule is arbitrary and unnecessary. They assert that to maintain a perfectly erect position all day is a hardship.

C.

PERSONAL.

Thomas D. Lockwood of Boston, the well-known telephone engineer, is in Chicago.

W. L. Church, superintendent of the Chicago Edison company, has removed his office to 569 Rookery.

James B. Olson, western manager, New York Insulated Wire company, has just returned to Chicago from a successful business trip.

John P. Barrett, city electrician of Chicago, has returned from a six weeks' pleasure trip to the Pacific coast. Prof. Barrett comes back in good health and spirits to again grapple with the problems of his department.

P. H. Alexander, New York, has been appointed manager of the light and power department of the Electric Selector & Signal company of New York. Mr. Alexander is well known in every branch of electrical enterprise, and his numerous friends will be pleased to see him once more located in New York.

NEW INCORPORATIONS.

Crescent Electric company, Chicago; capital stock, $10,000; incorporators, Walter H. Adams, Charles Cohenour and Bernard Elshoff.

ELECTRIC LIGHTING.

The Chicago Edison company has just sold a 60 kilowatt 110 volt dynamo to Mandel Bros. of Chicago—an addition to a large Edison isolated plant. The same company has sold two 15 kilowatt dynamos to W. W. Kimball & Co., Chicago.

The city council of Hawarden, Iowa, has approved the plans and specifications for a 1,000 light incandescent plant, prepared by William H. Bryan, consulting engineer, St. Louis. The city proposes to pay cash, and will receive bids up to May 25th.

The Pacific Electrical Storage company is placing a 60 kilowatt Westinghouse alternator for the Placerville Electric Light company at Placerville, Cal. The plant is to be operated by water power, using a 125 horse power Pelton water wheel. The Pacific Electrical Storage company is also placing a 100 light Westinghouse incandescent machine in the North Star Mine at Grass Valley, Cal.

A dispatch from Springfield, Ill., says that on May 4th bids for the construction of a municipal electric light plant were opened. Proposals were received from the Western Electric, Excelsior, Fort Wayne, General Electric companies and A. L. Ide & Son. The bids vary from $78,500 to $96,000. The Fort Wayne Electric company's bid is $79,000, and the General Electric $78,500, with Corliss engines. No action will be taken at present.

The city of Kalamazoo, Mich., is engaged in a discussion regarding the advisability of establishing a municipal lighting plant. The lighting committee of the city council, to which the subject was referred some time ago, is somewhat at sea as to the cost of running a plant, from the fact that the estimates of the local electric light company and those given by outside experts disagree to a remarkable extent. The Kalamazoo Electric company claims that it has lost money on the city contract.

At a recent meeting of the trustees of the village of Charlotte, N. Y., the contract for lighting the village by electricity was awarded to the Charlotte Light & Power company, which intends to begin business with a capital of $18,000. An order has been placed with the Westinghouse company for dynamos, and the work of setting poles and putting up wires will be commenced in a few days. The trustees voted to expend $2,000 the first year for twenty arc lights; they expect to have double that number next year. The company will extend its lighting area to Summerville and Windsor Beach and proposes to light the old and new boulevards extending from Rochester to Lake Ontario. The plant will be in operation by June 1st.

Considerable dissatisfaction is expressed by taxpayers of Indianapolis over the distribution of electric street lamps by the city officials. For instance, the *Journal* says: "The residents of Seventeenth street, between Broadway and Central avenue, are trying to figure out why the Board of Public Works deprives them of public illumination and yet locates an electric light in a cornfield, too far away from habitations to be of possible service. An electric light has been planted at what would be the intersection of Park avenue and Sixteenth street, were Park avenue extended. The Bruce heirs, however, stand in the way of extension of the avenue, and hence the street has never been opened. Along Seventeenth street fully one hundred people have no light."

ELECTRIC RAILWAYS.

The new electric railway between Rock Island and Davenport was opened on May 5th, when the first electric car crossed the Mississippi river on the government bridge. For five years the Davenport & Rock Island Railway company, composed of Chicago capitalists, has been working to this end. This is the only electric line across the river below St. Paul, excepting at St. Louis.

The competition of the trolley lines continues to have a depressing effect on the receipts of the Brooklyn Elevated Railroad company, and on Saturday, May 12th, further economizing measures were adopted. The men and women ticket agents, who have been working twelve hours a day at so much an hour, will be employed for only ten hours, and from 1 A. M. to 5 A. M. the fares will be collected by the conductors. The women, who have been getting $1.43 a day, will now only receive $1.20, and the men have been cut down from $2 to $1.67. Despite the frantic efforts of the New York and Brooklyn newspapers, the people patronize the trolley lines instead of the elevated.

In Hamburg the consumption of current by the street railways amounts already to one-fourth of that generated at the power houses of the lighting companies. Aix-la-Chapelle has decided to run its street railways electrically and to take the current from the electrical works constructed by the Electricity company, formerly Schuckert & Co., Nuremberg. The length of the first line to be operated is about 24 kilometers. As soon as the suburban lines are connected, as expected, the network will reach 30 kilometers. The present rails will be replaced by a double line. The hilly territory is unfavorable, as up-grades of 5 per cent. are numerous, and the maximum up-hill gradient amounts to 8 per cent. The system to be employed is the overhead trolley and 34 motor cars will be installed. Electrical equipment will be furnished by the Electricity company, and will be after the manner of the system at Zwickau and the one now in course of construction between Baden and Vöslau.

TELEPHONE.

Telephonic communication is being established between Madrid, Spain, and Barcelona via Saragossa, a distance of about 500 miles.

A private telephone line between Sandusky, Ohio, and Norwalk will be constructed by the Sandusky, Milan & Norwalk Electric Railway company.

According to the Vienna *New Free Press*, a scheme is on foot for connecting Vienna and Odessa by telephone. These two towns are about 700 miles apart.

The first step has been taken toward the establishment of telephonic communication between Copenhagen, Denmark, and Berlin. The finance committee of the Folksthing has reported in favor of the proposal of the German telegraph department that the cable between Copenhagen and Odensce shall be so laid as to form a part of the eventual telephone line to be carried by way of Odenser, Kolding and Hamburg, to Berlin.

Representatives of the New York and Eastern Telegraph & Telephone company had a conference with Mayor Schieren May 12th and urged him to approve of the resolution of the aldermen giving a company the franchise to operate in Brooklyn. They said that last year the New York & New Jersey company, which has had a monopoly of the business, made a profit of 24 per cent. on its capital. Owing to the exorbitant price there were only 4,571 telephones in Brooklyn. Mayor Schieren said that he favored competition in such matters, but that he would carefully investigate the standing of the company before deciding what action he would take.

The common council of Elmira, N. Y., has granted the telephone company of that city a franchise for constructing a conduit system and work will be begun at once. The company will put under ground this year the wires on Water street from Main to Lake, on Market street from State to Lake and on State street from Water to Second, thence on Second street to Railroad avenue, and on Railroad avenue to the Erie depot. This section is the most thickly traversed by wires, the number to be removed from Water street, including the cabled wires, being about 250. It is estimated that the cost of this work will approximate $20,000 and will take about two months to complete.

TELEGRAPH.

The Great Western Telegraph company of British Columbia will at once begin the construction of a line from Vancouver to Nanaimo.

The Western Union line between Hempstead and Austin, Tex., is being reconstructed under the direction of Captain C. H. Bristen of St. Louis and B. Cullim of Chicago. The line from Hempstead to Brenham, twenty-one miles, will have new poles and will be completed in first-class modern style. The line from Brenham to Austin, ninety-four miles, will be reconstructed thoroughly, which will require several hundred new poles. At present there are four wires to Brenham, and from that point to Austin there are three.

Speaking at a meeting of the Bankers' Institute, London, Nathaniel Cork, in the course of a paper read by him on "The Late Australian Banking Crisis," said: "An essential element to reconstruction (of the banks) was rapidity. But for the cable these reconstructions would not have been possible. Every scheme, balance-sheet, and circular had to be cabled, with all the directions as to meetings. They were not mere ordinary balance sheets which were thus wired, as the official receiver required an analysis of each item. These were the only documents the courts had to guide them, and it was not unusual for £400 or £500 to be spent on a telegram. One large bank which closed on May 16th was thus enabled to reopen at both ends of the world with its numereus branches on June 19th, in the same time as the mail brought the news of the stoppage."

LEGAL DECISIONS.

The Supreme Court of Oregon has decided that where a telephone company permits a wire liable to become charged from an electric wire to hang down to the sidewalk, it is bound to exercise such care as will guard the public against injury from it.

The Supreme Court of Michigan, in the case of Kennedy against the city of Lansing, has decided that a city is not liable to a passenger on an electric street car, who is struck and injured by a trolley pole placed in the gutter, near the track, where the city neither fixed the location of the track and poles nor owned them; the injury being caused by a defect in the street car system, and not by the condition of the street.

It was held by the Supreme Court of Nebraska in the case of the Western Union Telegraph company against the city of Fremont that municipal authorities are powerless to license or tax any business or avocation conducted exclusively outside of the municipality. A city of the second class may lawfully enact an ordinance imposing on telegraph companies a license tax of a reasonable sum per annum for the privilege of transacting the business of telegraphy within the city; and the fact that the telegrams received and delivered within the city were transmitted over the lines of the telegraph company from other points within the state, or that the messages received by it at its office or place of business in the city were transmitted to various other places in the state, does not invalidate the tax. State and municipal authorities are powerless to impose a tax upon messages to or from other states, since such a tax would be in conflict with that clause of the federal constitution which gives to congress the exclusive power to regulate commerce among the several states. Where a telegraph company is engaged in both interstate and intrastate business, an ordinance levying an occupation tax on that portion of such business which is carried on wholly within the state is not repugant to section 8, article 1, of the constitution of the United States, since it in no way interferes with or regulates interstate commerce.

The rights of a city in contracting for lights were defined in an interesting manner by the United States Supreme Court in the case of the Newport Light company against the city of Newport. A gas company having, by contract an exclusive right to light the streets of a city with gas obtained an injunction preventing the city from making any contract with other persons for lighting with "gas or otherwise," which was affirmed by the state Court of Appeals. Afterward the city procured an amendment of its charter, giving power to contract for lighting with electricity, with a proviso that no existing contracts

should be interfered with. An act was also passed incorporating an electric light company, with which the city contracted for lighting the streets. The gas company thereupon procured an adjudication that the city council was in contempt for violating the injunction, but on an appeal this judgment was reversed, the court holding that, as the gas company had no contract right to light with electricity, the city could contract therefor with a third party, if it chose to pay for both gas and electricity, but that it could not dispense with the gas company's gas, and, if it did so, this would be a mere breach of contract, actionable at law. This decision involved no federal question warranting an appeal to the United States Supreme Court, although the Court of Appeals ruled adversely upon a claim that the acts amending the charter and incorporating the electric company impaired the obligation of the gas company's contract.

MISCELLANEOUS.

Lord Aberdeen, governor-general of Canada, has purchased an electric launch for use at Ottawa.

The argument on the motion for injuction made by the Consolidated Electric Storage company against the Electric Storage Battery company came on for hearing before Judge Green, at Trenton, N. J., on Tuesday May 8th. It will be resumed on May 29th.

It is probable that a new electric plant will be established in New Britain, Conn., shortly, as plans are being perfected to organize a company for the manufacture of electrical appliances. The proposed capital stock will be $100,000, and the proposed name will be the Improved Electrical Machine company. Burton E. Baker, an electrician, formerly of Hartford, but lately with the Thomson-Houston company, is the projector of the enterprise. A number of appliances for domestic use are to be made, such as appliances for heating and cooking.

TRADE NEWS.

W. P. Jones, secretary of the Law Battery company of New York, left this week for an extended trip through the South and West.

The Electric Storage Battery company of Philadelphia has opened an office in the Aldrich Court building, 45 Broadway, New York, where cells of the chloride accumulator may be seen by those interested.

The Automatic Switch company of Baltimore has issued a circular containing a few testimonials from central station men of experience and reputation who have used the company's motor starters and recommend them highly.

The Gerson Electrical company of Philadelphia is manufacturing telephones which it says it will sell outright. The company has, it is claimed, a complete telephone system and is ready to furnish telephones for long-distance work.

President Norman Marshall, of the Iona Manufacturing company of Boston, reports that the company's business for the month of April was in excess of last year, and that the prospects are unusually bright, considering the past few months.

The new firm of Ross & Hailey, 35 Center street, New York, will make a specialty of all kinds of repairs in the electrical line, including rewinding of armatures. They will also engage in expert work and report upon special electrical apparatus.

The Day-Moberg Electric company of Boston has recently got out an interesting little pamphlet descriptive of the Jupiter storage battery, which is having a good sale in connection with lamps where only a little light is desirable. It is peculiarly adapted for portable work, and can be used in a large variety of light work.

The Medinah Temple, Chicago, is being wired with N. I. R. wire throughout. The Metropolitan Electric company, Chicago, has the western agency for this wire and has had remarkable success with it throughout the West. The Metropolitan company has been appointed general western agent for the Kester arc lamp, which is manufactured by the F. P. Little Electrical Construction & Supply company, Buffalo, N. Y.

The brisk demand for interior conduit which the Central Electric company, Chicago, is experiencing is an indication of the fact that architects and builders have long felt the need of a reliable conduit. Among the numerous orders received last week was one for 100,000 feet of brass covered conduit for the Garfield building, Cleveland, Ohio. The iron armored interior conduit for electric lighting, for which the Central Electric company is the western agent, has been adopted by the United States government, and is being used in all the government buildings.

The Electric Appliance company, Chicago, reports an increasing demand for the Allen soldering stick. It is said that, notwithstanding the fact that it has been introduced only a few months, it is now in general use by nearly every station and construction man in the country, with very satisfactory results. The Electric Appliance company is pleased with the success of the experiment of carrying an exceptionally large stock of Packard lamps in Chicago. The company's sales during the last month have been more than satisfactory to the manufacturers as well as themselves, particularly in view of the fact that the season for large lamp business is generally considered to have gone by some months ago.

The W. S. Hill Electric company of Boston since January 1st has been obliged to run overtime and add a large amount of new machinery. Now the company has under consideration the leasing of more commodious quarters. The company has just shipped a number of handsome switchboards, among which is one to the Peninsular Electric Light & Power company of Houghton, Mich., one to the Peninsular Electric Engineering company of Detroit, Mich., one for the Equitable Building, Boston, and one for the Eastern Yacht Club at Marblehead, Mass. The company has recently received another large order for switches, comprising 126 500-ampere switches and 16 4,000-ampere switches, besides other orders for very large switches for 500 volt railroad circuits.

Among the electrical concerns that have enjoyed prosperity during the last season the Eastern Electric Cable company of Boston is a conspicuous example. It is said of this concern that it never fails to declare its 6 per cent. half yearly dividend, and that it has such a substantial reserve fund to which it is always adding, that the company is equal to any emergency. One who is acquainted with the affairs of the company says that if it needs land on which to erect additional buildings, it goes ahead and secures what it wants, pays spot cash and up goes the new factory of several stories. The latest of these purchases is over 16,000 feet of land near the big new factory now nearly complete.

The new home of the American Electrical Works, the old Richmond Paper Mills property, including 28 acres of land at East Providence, R. I., is completed, and the three new buildings are now ready for occupancy. The plant cost the paper company $1,000,000, and this value has been greatly enhanced by the additions made since it passed into the possession of the present owners. The buildings occupy 113,000 square feet; they are admirably arranged for the purposes of the occupants, and their location on the line of the N. Y., N. H. & H. R. R. company adds much to their value. The settlement is now known as Phillipsdale, and is about three miles from the city of Providence, on the Seekonk river. President Phillips deserves all the good fortune which has attended his efforts and those of his associates, Messrs. Sawyer, Hathaway, Remington, Ackerman, Carroll, and his son, E. Rowland Phillips. The electrical fraternity generally will congratulate Mr. Phillips and his associates upon this occasion and wish them continued prosperity in their new home.

During the past two years the Electric Selector & Signal company, 45 Broad street, New York, has been perfecting improvements in the construction and operation of the electric light and power controller made by this company. This device controls the output of current to any individual lamp or motor, or group of lamps or motors, starting and extinguishing lamps, and regulating the hours motors are to be operated from the central station. The apparatus consists of three distinct parts—the transmitter, the selector, and the switch. The transmitter consists principally of a disk or a number of disks arranged on an axis, each disk having on its periphery certain elevations or contact points, which, while rotating, make contact with a metallic brush, and through it send out current in impulses, which, in turn, actuate the other devices. The selector receives the electrical impulses from the transmitter. It consists of a magnet and one disk the notches in the latter corresponding with the elevations on the periphery of the transmitter disk which is to actuate it. If the right number of impulses are received from the transmitter, two contact points are closed, and the current flowing through them operates the switch or switches to be thrown by it. The switch can be made of any pattern or any size, and is a simple magnet switch operated by the armature of the magnet, which receives its current from the transmitter through the contact points of the selector. More than one switch may be operated by each selector. There are many admirable features in this system which will appeal to all experienced central station men.

BUSINESS.

B. J. Arnold, Chicago, has been retained by the Board of Trade, Chicago, to examine and make a report on its electric lighting plant.

The new Vulca bushing which the New York Insulated Wire company has just put on the market is meeting with great favor. J. B. Olson, the western manager of the company, says that he is unable to keep up with the demand.

The fan motor season opened up earlier than usual this year, and the Central Electric company, Chicago, is filling orders for its well-known type with its accustomed promptness. Okonite wire continues to be in great demand in the West, and the Central company is kept busy in its endeavor to meet the constantly increasing growth of this branch of its business.

Ziegler Bros. of 73 Federal street, Boston, Mass., well-known manufacturer of electrical instruments, have outgrown their present quarters and are moving to 141 Franklin street, where nearly three times the amount of room will be had. This concern is now considering the manufacture of a number of important electrical specialties which will be placed on the market in the near future.

"I X L" triple braided wire is one of the latest specialties which the Metropolitan Electric company, Chicago, has added to its large stock of supplies. The wire is manufactured by the Collyer Insulated Wire company, Pawtucket, R. I. The Metropolitan company is the general western agent. This company will handle the Crocker-Wheeler disk fan and bracket fan motor which have just been put on the market.

The Berlin Iron Bridge company of East Berlin, Conn., is putting up a gas house extension for the Brookline Gas company at Allston, Mass. The new terminal facilities for the New York, New Haven & Hartford railroad, at Providence, R. I., will necessitate two large bridges, which will be furnished by the Berlin Iron Bridge company. These bridges will carry sixteen tracks over Gaspee street, Promenade street and Woonasquatucket river. The bridges will be plate girders, resting on abutments at the street line and columns at the curb line. No floor beams or stringers will be used, but in the place of these there will be a metal floor supporting ballast in which the ties and rails will be bedded. The work will require about 4,500 tons of open hearth steel material. The Berlin company will be allowed six months in which to complete the work.

A representative of the WESTERN ELECTRICIAN recently visited the works of the Partridge Carbon company at Sandusky, O., and by the courtesy of Secretary J. S. Speer was allowed to inspect this interesting factory. The Partridge company's makes electric light carbons and carbon motor brushes, but the motor brush is its specialty, and a glance at a sample of the work turned out shows the secret of the company's success in building up a large and lucrative trade. It is claimed that the Partridge brush is of such a quality that it will wear one-quarter longer than any other, and will keep a commutator in perfect condition; in fact, a Cincinnati company wrote the Partridge company that it had but one complaint to offer, and that was that the Partridge motor brush lasted too long. Both hard and soft brushes are made, and samples may be had for the asking. One reason for the Partridge company's success lies in the fact that its policy is mapped by men with a keen insight into the technical as well as the purely business side of the company's affairs. Both Secretary Speer and Manager James Partridge are men of large experience in the carbon business, Mr. Partridge being so through his well-known and valuable practical work some years ago in Cleveland, and Mr. Speer through his energetic and business-like policy in extending the trade of the present company. The Partridge company is rapidly pushing its goods out through the West with most favorable prospects. The factory has a capacity per day of 15,000 motor brushes and 35,000 electric light carbons.

ELECTRICAL PATENTS.

Issued May 8, 1894.

519,328. Contracting Device for Electric Railways. D. F. Graham and W. P. Allen, Chicago, Ill.

519,330. Galvanic Battery. C. W. Hertal, Berlin, Germany.

519,334. Carbon Holder for Arc Lamps. Erwin Lavens, Brooklyn, N. Y.

519,335. Reactive Coil. Hermann Lemp, Lynn, Mass.

519,336. Electric Welding Machine. Hermann Lemp and Carl Gustaf Anderson, Lynn, Mass.

519,338. Electric Switch. J. F. McElroy, Albany, N. Y.

519,346. Apparatus for Telegraphic or Telephonic Transmission. M. I. Pupin, New York, N. Y.

519,347. Transformer for Telegraphic, Telephonic or other Electrical Systems. M. I. Pupin, New York, N. Y.

519,376. Alternating Current Transformer. Charles S. Bradley, Avon, N. Y.

The object of the invention is to produce from polyphase currents an induced alternating current of single phase.

519,377. Generating and Utilizing Electric Currents of High Potential. Charles S. Bradley, Avon, N. Y.

519,380. Conduit Electric Railway. James F. Cook, Mansfield, Pa.

519,382. Safety Water Column. H. Engel, Cleveland, O.

519,446. Trolley Wire Hanger. A. B. Crounse and C. A. Rutledge, Passaic, N. J.

519,482. Electric Accumulator or Secondary Battery. A. J. Smith, London, England.

The invention consists of a method of making secondary batteries, in which sheets or plates of lead of any suitable dimension are covered with a suitable oxide of lead, and by means of a mechanical process or kneading intermingled with the metallic lead on one or both sides of the plate.

519,497. Electric Fire Alarm Transmitter. Adolf Dunish, Ravenna, O.

519,519. Trolley Wire Crossing. Edward H. Allen, Cramer's Hill, N. J.

519,602. Storage Battery Plate. C. P. Elieson, London, England.

The invention relates to Plante type and consists of a storage battery plate, built up of parallel layers of corrugated and perforated metal, the corrugations of one layer being at an angle to those of the adjacent layer so as to prevent coinciding and nesting, and to preserve an even and constant groove space between a fixed and permanent bracing of the layers in relation to each other. The corrugations are parallel to the plane of the plate.

519,621. Trolley Wire Hanger. C. F. Strausburg, Lincoln, Neb.

519,634. Electrical Temperature Annunciator. Ernst Kloss, Stettin, Germany.

519,662. Electro-magnetic Tube. Charles F. Carpenter, Louisville, Ky.

519,674. Electrical Propulsion of Railway Cars. J. J. Heilmann, Belfort, France.

519,686. Method of Operating Electric Motors. John Sellers Bancroft, Philadelphia, Pa.

The invention relates to a method of operating any or all of a group of motors, the armatures of which receive their current from a common source of supply.

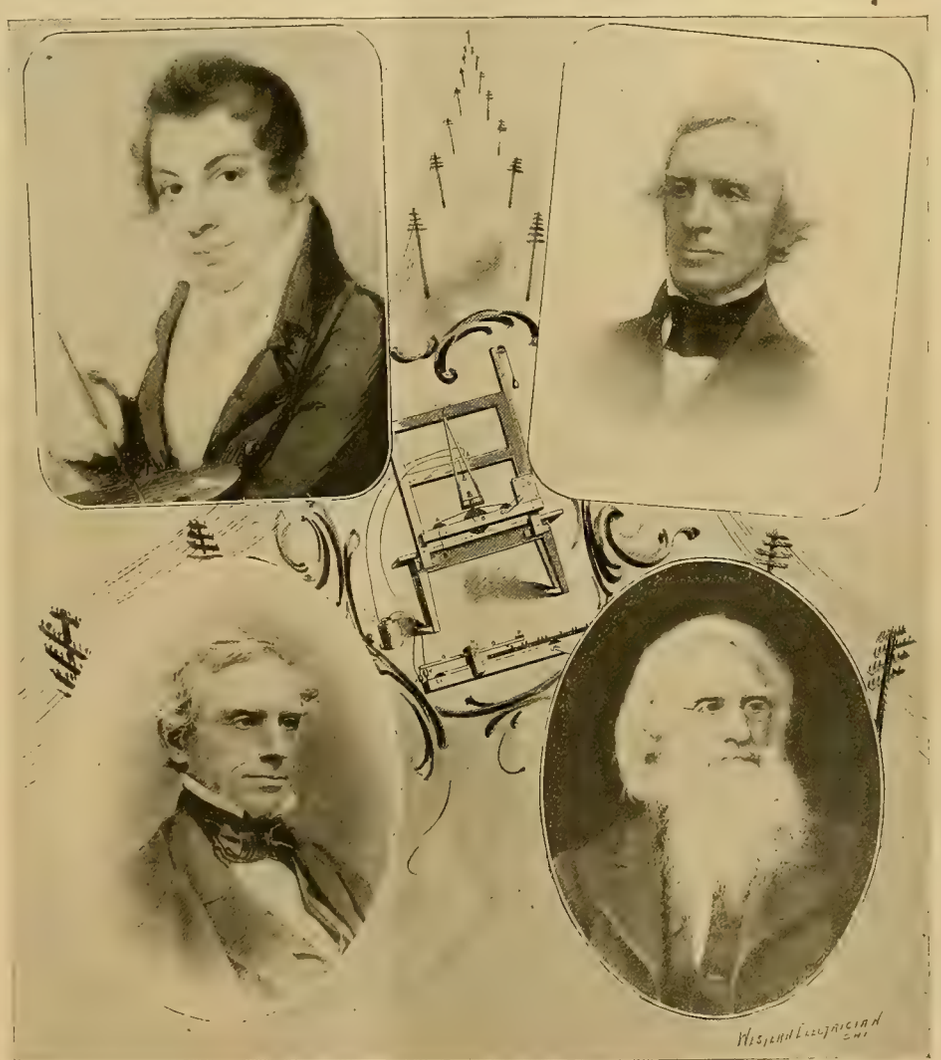
Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, MAY 26, 1894. No. 21

Morsiana.

It would doubtless be a work of supererogation to inform any reader of this journal that it was on May 24, 1844, that the first telegraph message transmitted as a public test was flashed over the wires from Washington to Baltimore. The words of that message, "What hath God wrought?" have become historical, because, although not the expresion of the first transmission of speech by the electric telegraph, they may nevertheless be very properly said to have electrified the world, as they marked the establishment of the art of telegraphy. It is therefore particularly appropriate, on the fiftieth anniversary of this important event, to glance at some of the leading incidents in the life of the inventor of the telegraph, and to present, if possible, some new facts bearing upon his career and his great achievement. It is not intended in this article to attempt a connected and elaborate biographical sketch of Prof. Morse, or to offer a critical estimate of the value of his invention to the human race. Volumes have been written on these subjects, and the main outlines of the story must be familiar to all. That this important half-century mark may not pass unnoticed, however, a few side-lights on this great American and his work have been collected for presentation at this time, together with Prof. Morse's own account of the invention of the telegraph. It is proper to remark that all the half-tone illustrations and portraits accompanying this article are made from original photographs, many of which are now reproduced for the first time. For these pictures the WESTERN ELECTRICIAN is indebted to S. F. B. Morse of Chicago, the grandson and namesake of Prof. Morse.



The Young Artist. At Sixty. SAMUEL FINLEY BREESE MORSE. The Inventor. In Later Years.

PROPOSED STATUE IN WASHINGTON.

It has been proposed to make the fiftieth anniversary of the famous Washington-Baltimore dispatch by an appropriation by Congress of a sum sufficient to defray the cost of erecting a bronze statue of Prof. Morse in front of the Congressional Library building at Washington, and it had been hoped that the bill might become a law on the very day marking the close of the fifty years, May 24th. It is now too late for this, but there still remains time to secure an appropriation at this session of Congress if all interested in perpetuating the memory of the great inventor will bestir themselves and use their influence with their representatives in the House. The project is a most laudable one, and an appropriation could doubtless be secured without difficulty if the idea were brought home to the representatives by personal letters and interviews.

PORTRAITS OF MORSE.

The pictured face of Samuel Finley Breese Morse, as he appeared in the decade before his death, full of years and honors, is a familiar one, but his appearance in youth and during middle life is not so well known. An interesting collection of four portraits is here presented, each picture representing a different period in his life. The first, showing Morse as a young man in the twenties, is of exceptional interest from the fact that it is a reproduction of a miniature painted on ivory by Morse himself, who secured the likeness by looking in a mirror. The young artist represents himself with palette and brushes, and the bright, eager face looking out of the picture already bears the promise of a notable career. This miniature is in the possession of S. F. B. Morse of Chicago. The second portrait, at the right of the first, shows Morse as he appeared at the time that he made his world-famous invention. The face is that of a man of fifty or thereabouts, with character and determination written in every line. There is about this picture an air of indifference to minor details of personal appearance, as of a man too deeply engrossed in an absorbing pursuit to pay attention to such trifles. This impression, however, is notably absent in the succeding picture, taken about ten years later, when Prof. Morse's reputation was widely and firmly established. The second and third pictures are reproductions from old daguerreotypes. The fourth, showing the honored inventor in his declining years, was made from a photograph taken in New York.

GENEALOGY.

Morse was the descendant of a long line of New England ancestors and was a fine example of the best Yankee type. His father, Rev. Jedediah Morse, D. D., "minister to the congregation at Charlestown," as he described himself, was an able and learned divine and a man of stern and unyielding character. He was a scholar and became widely known as the author of the first American treatise on geography. This book, few copies of which are now in existence, was published about the time of the birth of Dr. Morse's son Samuel, who was destined to make the family name famous. Prof. Morse inherited much of his father's strong will and deep religious conviction. He was twice married, having three children by his first wife and four by the second. The children of the first marriage were Charles Walker Morse, Susan Walker Morse (afterward Mrs. Edward Lind of Arroyo, Porto Rico, W. I.) and James E. F. Morse. By the second marriage Prof. Morse's children were Samuel Arthur Breese Morse, Cornelia Livingston Morse (now Mrs. Franz Rummel of Berlin, Germany), William Goodrich Morse and Edward Lind Morse. Turning now to Prof. Morse's eldest son, Charles Walker Morse, we find his decendants to be Bleecker Lansing Morse, Samuel Finley Breese Morse and Susan Lind Morse (now Mrs. George K. Perry of New York). All of these are living, Bleecker Lansing Morse, the elder son, residing in New Orleans, where a family of five children represents the fourth generation. The second son of Prof. Morse's eldest son is the Chicago representative of the family.

MORSE AS AN ARTIST.

Overshadowed by his great fame as the inventor of the electric telegraph, Morse's career as an artist has not received wide public recognition. And yet, from about 1820 until, say, 1840, S. F. B. Morse stood in the very foremost rank of American artists. Allusion has already been made to Prof. Morse's portrait of himself, and indeed it may be said that it was as a portrait painter that Prof. Morse was best known in art. Many of his pictures are in existence and are highly prized. Such was his influence with his fellow artists in New York, as early as 1826, that he is accredited with the honor of being the chief founder of the National Academy of Design, which was established in that year. With this institution Mr. Morse was connected for many years. P. B. Wight, the architect of the beautiful building occupied by the National Academy in New York, now residing in Chicago, told a representative of the WESTERN ELECTRICIAN, in a recent conversation on this subject, that he considered Samuel F. B. Morse to be the legitimate successor of Gilbert Stuart as the great American portrait painter. An interesting incident involving Morse's retirement as an artist and his public appearance as an electrician occurred in 1837. Congress passed a law authorizing a committee to engage with four American artists for the execution of an equal number of paintings to fill the vacant panels in the rotunda of the capitol, each to cost $12,000. Prof. Morse greatly desired to secure one of these commissions—for which he and his friends thought he was well qualified—and was much disappointed when, through political enmity, attributed at the time to John Quincy Adams, he was de-

nied the honor. His fellow academicians sympathized with him and resented the action of Congress. They formed an association for the purpose of retaining Morse to paint a historical picture, and $3,000 was quickly raised. Mr. Morse was greatly affected by this professional generosity, and expressed his determination of undertaking the commission. The picture was begun and some of the money was paid in, but it was destined never to be finished, as Prof. Morse's attention was now almost entirely taken up by his work on the electric telegraph. On March 15, 1838, he wrote a letter to the association, in which he said:

Circumstances relating to telegraph, invented by me in 1832, will require my attention for an indefinite time, and I am about to visit Europe, principally in reference to matters connected with this invention. At the same time, indeed, I have in view some studies connected with the picture which the association have commissioned me to paint for them. Yet I ought not to conceal from the gentlemen who have so generously formed the association that circumstances may arise in relation to the telegraph which may make it a paramount duty to myself and to my country to suspend for a season the commission with which they have honored me. In this state of suspense I have to request that no further collections of the installments be made until my return from Europe in the autumn, at which time I shall doubtless have it in my power to acquaint you with the course which it may be thought advisable to pursue. If possible, I wish as soon as practicable to relieve myself of the cares of the telegraph that I may have my time to devote more strenuously than ever to the execution of my picture and the benefit of the academy and of the arts.

Prof. Morse fortunately did not relieve himself of the cares of the telegraph, however, and on November 30, 1841, he returned to the stockholders, with interest, all the money he had received for the picture. Mr. Morse served continuously as president of the Academy until 1845, when, the value of the telegraph having been demonstrated, he resigned, owing to his work for the government. In 1861 Prof. Morse consented to again serve one year as president in honor of the occupancy of the new building.

BIRTHPLACE OF THE INVENTOR.

Samuel Finley Breese Morse was born in Charlestown, Mass., in 1791. The old house is still standing, and its present appearance is shown by the reproduction of a recent photograph given on this page. It can be found at the foot of Breed's Hill, and the spot on which it stands is within a stone's throw of the field of the battle of Bunker Hill. Whether the structure was in existence at the time of the Revolution is not certainly known; some date its erection back to 1769. If not in existence at the time of the battle of Bunker Hill, however, it must have been built soon after. As will be seen, the house is a

HOUSE WHERE MORSE WAS BORN.

frame structure of considerable size. At present the two stores on the ground floor are occupied by a grocer and a baker. The house is saved, however, from being entirely commonplace to the casual observer by a conspicuous white marble tablet bearing this inscription:

Here was born
SAMUEL FINLEY BREESE MORSE,
27 April, 1791,
Inventor of the
Electric Telegraph.

UNIVERSITY BUILDING.

In July, 1835, Morse fitted up a studio in the then new building of the University of the City of New York, on Washington Square, in that city, which is now being torn down. This large building, for sixty years a landmark in New York city, was erected with the idea of serving exclusively for an institution of higher education.

UNIVERSITY BUILDING, NEW YORK, WHERE MORSE CARRIED ON HIS TELEGRAPHIC EXPERIMENTS.

Financial reverses overtook the college, however, and the management was compelled to rent many of the rooms as bachelor apartments. Several artists were quartered here, Morse, who was a lecturer before the students, being one of them. Here he worked to bring his idea of the electric telegraph, first conceived in 1832, to perfection, and here, in 1837, the first private exhibitions were given. Early in 1838 Prof. Morse succeeded in attracting the attention of Congress to his invention, and on June 24th of that year he gave an exhibition by invitation prior to leaving for Washington. Among the guests on this occasion was Thomas S. Cummings, treasurer of the National Academy of Design, and to him Prof. Morse addressed the message, "Attention, the universe; by kingdoms right wheel." This, in facetious recognition of military promotion that had recently come to Mr. Cummings, seems to be the first telegraphic message of which there is record. A picture of the University building is given below. Prof. Morse's rooms were on the third or top floor of the main portion of the building. In testing the telegraph he strung wires about the walls of Room 29, in the northwestern corner of the first floor, where the first exhibitions were given with the crude instruments made by his own hands. Afterward Prof. Morse had better instruments made and led his wires to a hotel across the park, on the corner of Thompson street.

CITY AND COUNTRY HOUSES.

The later years of Prof. Morse's life were passed amid the surroundings of well-earned wealth. His country place was at Poughkeepsie on a hill overlooking the noble Hudson and was called Locust Grove. This was his favorite residence. The picture given on page 257, reproduced from a rare photograph taken in June, 1871, shows the house, with the venerable professor on the lawn with his wife and daughter Cornelia, now Mrs. Rummel of Berlin. This house was a pilgrimage for many distinguished men who came to pay their respects to the renowned Morse. The city house of Prof. Morse was at 5 West Twenty-second street, New York, and is also illustrated on page 257. Here he spent his winters and died on April 2, 1872, lacking less than a month of having completed his eighty-first year. The house is marked by a tablet bearing the inscription: "In this house S. F. B. Morse lived for many years and died."

MORSE MONUMENTS.

The Central Park statue of Prof. Morse, shown on page 258, was unveiled on June 10, 1871, nearly a year before the death of the man it honored. It was built with money obtained from a great number of small subscriptions, mostly from persons depending on the telegraph for a livelihood. It is of heroic size, and represents Prof. Morse as holding the famous message of 1844, and devoutly recognizing the significance of the words, "What hath God wrought?" The handsome and elaborate Morse monument in Greenwood Cemetery, Brooklyn, is illustrated on page 258. This monument bears three faces, one each for Prof. Morse and his brothers Sidney and Richard. The burial plat is circular, the deceased descendents of each of the brothers lying in the portion adjacent to the side of the monument devoted to their ancestor.

PERSONAL TRAITS.

Prof. Morse was a scholar and a graduate of Yale College, an easy and graceful writer, one of the foremost painters of the country in that period of his life devoted to art, and an ingenious mechanic, having invented, before the telegraph, an improved pump and a marble-cutting machine. He was also thoroughly grounded in the science of electricity as it was known in his day, having become interested in the subject early in his college course under the instruction of Prof. Silliman. In him were combined in a rare degree great versatility, remarkable mental attainments and plodding perseverance. In person Prof. Morse was tall, slender and of erect stature. He

possessed dignity without austerity and greatly enjoyed the joys of domestic life. As his chief biographer, Dr. Prime, says of him, "He died leaving to his children a spotless and illustrious name and to his country the honor of having given birth to the only electro-magnetic recording telegraph whose line is gone out through all the earth and its words to the end of the world." It is said of him that he received from foreign governments more public honors than were ever paid to any other private American citizen.

COUNTRY SEAT OF PROF. MORSE.

THE S. F. B. MORSE OF TO-DAY.

Of all Prof. Morse's descendants it is interesting to know that but one is engaged in electrical pursuits, that one being his grandson and namesake, S. F. B. Morse of Chicago, whose portrait is herewith given. Mr. Morse is an old telegrapher, filling responsible positions for the Western Union and other companies in New York, from 1872 until 1876. In the latter year, at the Centennial, he was manager of the interests of the old Atlantic & Pacific company, which obtained the concession for supplying all telegrapic facilities at the exhibition. After that, until 1889, Mr. Morse was engaged in various non-electric pursuits. In that year he became vice-presidant of a company formed to exploit a new electrical watchmen's clock, and, this venture not proving profitable, he later removed to Kansas City as the general western and southern agent of a New York company engaged in a general electrical business. Early in 1892 Mr. Morse came to Chicago, and he is now one of a firm handling the western business of a large insulated wire company. Mr. Morse has a vivid recollection of his distinguished grandfather and has made a large and interesting collection of books, pamphlets, newspaper clippings, letters and pictures relating to him. The S. F. B. Morse of this generation is a cultivated and affable gentleman, well liked by the electrical fraternity of Chicago.

MORSE'S OWN ACCOUNT OF THE INVENTION OF THE TELEGRAPH.

[From a pamphlet prepared and published in Paris in 1867.]

In the month of October, 1832, I left France for the United States in the packet ship Sully. Early in the voyage, in the course of conversations in the cabin, some of the facts in relation to electricity, familiar to me from my college days, were casually brought to my recollection in describing the then recent discovery of the means of obtaining the electric spark from the magnet, a discovery which demonstrated the intimate relations of magnetism and electricity. The fact that electricity passed with such rapidity through a space of many miles was alluded to, in which Franklin's opinion of the instantaneity of the passage of electricity was brought to notice. This led me to remark that "if that were so, and the presence of electricity could be made visible in any desired part of the circuit, I see no reason why intelligence might not be transmitted instantaneously by electricity." This was the crude seed, which at once took root, and, with the favoring leisure of a long voyage and a mind unoccupied with other studies, grew into form, absorbing my thoughts in the sleepless hours of the night, and turning the tedium of the voyage into an agreeable pastime. Before the end of the voyage the invention had the following attributes.

I may observe, in passing, that my aim at the outset was simplicity of means as well as result. Hence I devised a single circuit of conductors from some generator of electricity. I planned a system of signs consisting of dots or points and spaces to represent numerals and two modes of causing the electricity to mark or imprint these signs upon a strip or ribbon of paper. One was by chemical decomposition of a salt which should discolor the paper; the other was by the mechanical action of the electro-magnet, operating upon the paper by a lever charged at one extremity with a pen or pencil. I conceived the plan of moving the paper ribbon at a regular rate by means of clock-work machinery to receive the signs. These processes, as well as the mathamatically-calculated signs, devised for and adapted to recording, were sketched in my sketch book. I also drew in my sketch book modes of interring the conductors in tubes in the earth, and, soon after landing, planned and drew out the method upon posts. This was the general condition of the invention (with the exception of the plan upon posts) when I arrived in New York on the 15th of November, 1832.

Among the original characteristics of the invention as devised on board the ship, one of the most important was the mathmatically-calculated signs adapted to recording. As these signs have ever since played a most important part in the modern telegraphs, they would seem to demand here a more distinct notice of their origin.

In reflecting on the operations of electricity as a proposed agent in telegraphy, I was aware that its presence in a conductor of moderate length could be indicated in several ways. The physical effects in a shock; the visible spark; visible bubbles during decomposition, and marks left from decomposition; its magnetic effects upon soft iron and steel; and its calorific effects—these were all well-known phenomena. Could any of these be made available for recording, and at a great distance? This was the important problem to be solved. Electricity had been flashed many miles through a conductor, apparently instantaneously, and produced some of these effects at a distance. May not all of them, likewise, be produced at a distance? If so, which of them seemed to promise the surest result of a permanent record? Static electricity, as an agent, was first proposed, but was quickly dismissed as too uncontrollable, and I directed my attention exclusively to the phenomena of dynamic electric ty. The decomposition of a salt having a metallic basis would leave a mark upon paper or cloth, but what sal ? Some would probably answer the purpose. Assuming, therefore, that such a salt could be found, how was it to be used? If a strip of paper or cloth were moistened with the salt and were then simply put in contact with a conductor charged with electricity, would there be any effect upon the paper? A magne ic effect is produced exterior to the charged conductor: is there any salt or substance so sensitive as to be affected either by decomposition, or in any other way by this magnetic influence by simple contact with an electrically charged wire? It was doubtful, but worth an experiment.

But, if such effect were verified by experiment, it was conceived that marks like those in Fig. 1 might be made across the moistened paper, as it passed beneath and in contact with the conjunctive wire AB, when the wire was electrically charged and discharged.

It is needless to add that on trial no such effect was produced by the magnetic properties of an electrically charged wire upon any salt that I afterward submitted to the experiment. Nevertheless, it is perceived that, had this device (which was noted down for testing) been verified, the simplest of all modes of recording would have been the result.

MORSE'S NEW YORK HOUSE.

The nearest approach to this simplicity seemed to be the passing of the chemically prepared paper between the two broken parts of a circuit, so that the electricity should pass through the moistened paper or cloth; this would mark a point or dot when the circuit was closed, and by

rapid closing and opening of the circuit, while the paper was moved regularly forward, points or dots, in any required groups, could be made at will. But what salt would best produce this result was to be determined after reaching the end of the voyage. In the meantime, as I originally proposed to record numerals only, intending to indicate words and sentences by numbers, it was a desideratum to arrange the ten digits to be represented by dots or points within as small a space as possible. The first and most obvious mode seemed to be the following:

1 2 3 4 5 6 7 8 9 10

. . . . . .

But a few minutes' reflection showed that after five dots or points, the number of dots became inconveniently numerous in indicating the larger digits; hence, it occurred to me that, by extending the spaces appropriated to the five larger digits, giving them a greater space value than was possessed by the five smaller digits, I might reduce the number of dots necessary to indicate any of the ten digits, within five dots. On this principle, therefore, I constructed the following signs for the ten numerals, and devised the types for regulating the opening and closing of an electric circuit. See Fig. 2.

On inspecting Fig. 2 it will be perceived that the types were to be divided into definite parts.

Type 1 contains	4	parts and appropriates	1	part to its cog and	3	to its space
" 2 "	6	"	3	parts " "	3	"
" 3 "	8	"	5	" " "	3	"
" 4 "	10	"	7	" " "	3	"
" 5 "	12	"	9	" " "	3	"
" 6 "	6	"	1	part "	5	"
" 7 "	8	"	3	parts "	5	"
" 8 "	10	"	5	" "	5	"
" 9 "	12	"	7	" "	5	"
" 0 "	14	"	9	" "	5	"

Each of the first five digits, therefore, is indicated by a space of three parts, and

Each of the last five digits is indicated by a space of five parts.

The space type for separating completed numbers, whether single or compounded, contains six parts.

The length of the spaces, therefore, was an element to be used in determining the difference between the class of the first five digits and the class of the last five digits, and not simply the number of dots or points. Whether one dot was to be read as numeral 1 or as numeral 6 was to be determined by the length of the space after it, and for the purpose of measuring this space in the last numeral of a dispatch, the single dot or point was to be used as a supernumerary finale to every dispatch.

A space of the length of nine of more parts, after a dot or group of dots, indicates the dot or group of dots to be a complete number, whether single or compounded.

A space less than the length of the nine parts, after a dot or group of dots, indicates that they are a portion of a compounded number.

An example will illustrate this first mode of recording that was proposed. Suppose the numbers to be telegraphed are 77-8-92, the type would be arranged as in Fig. 3. The record would show two dots, then a space

MORSE FAMILY MONUMENT IN GREENWOOD CEMETERY.

of five parts, which being less than nine parts, determines the two dots to belong to numeral 7, the five parts being its proper or natural space, and that it is one of a compounded number, then follow two similar dots, but followed by a space of eleven parts, which, consisting of more than nine parts, shows that a space type of six parts has been inserted, separating this last group from the next; six parts subtracted from the eleven parts leave five parts for the proper or natural space of the last numeral, showing it to be, like the first, the numeral 7. Next come three dots and also followed by a space of eleven parts, which, consisting of more than nine parts isolates the numeral, and shows that a space type of six parts must be subtracted from the eleven, leaving five parts for the natural or proper space of the last numeral, indicating, therefore, the numeral 8. Then comes four dots, followed by a space of five parts, which being less than nine parts, shows the four dots to be a numeral belonging to a compounded number, and that it belongs to the class of the five larger digits and indicates the numeral 9. Next comes two dots followed by a space of three parts, which being less than nine parts, shows it to belong to the class of the first five digits, and, therefore, indicates the numeral 2, because it is succeeded by the final 1, which is not to be regarded except as serving to measure the space to determine the character of the previous numeral.

This method (in the light of my improvements of the code, which very soon followed after the first practical test) seems crude and even impractical, especially in view of my perfected alphabetic code devised as early as 1835, and now, with some comparatively slight improvements, in use throughout the world. But, cumbrous and inconvenient as it was in its earliest stages, if compared in its results with the results of the semaphoric modes in use in

THE S. F. B. MORSE OF TO DAY.

that day, it will be perceived that it was even then a great step in advance.

A day had scarcely passed after my landing before I commenced the construction of the invention from the plans and drawings made on board the ship. The signs to be recorded or imprinted it was necessary to embody in a species of type, the name I gave to the cogged pieces which were to make the required closings and openings of the circuit of conductors necessary to mark or imprint the points or signs for numerals upon the strip of paper at the regulated intervals of time; the paper or ribbon having a regular movement, while the type performed the closing and opening of the circuit at irregular intervals (and thus broke the continuous line of the regular movement of the paper into irregular parts at pleasure) and furnished the means of breaking the line into dots and spaces in such variety as at once to enable me not only to construct the numerals, but eventually, as will be seen by the different combinations of long lines, short lines, or points and spaces, all the different letters of the alphabet. The type proposed at this time consisted of thin strips of type metal with cogs varied at intervals, as seen in Fig. 2. These, by means of a mechanical movement hereinafter described were made, and intended for closing and opening the circuit at the desired times. These types, therefore, for imprinting at a distance were, at that time, an essential part of the machinery in process of construction; and, having more facilities, immediately on my arrival, for elaborating these types than for other parts of the machinery, they were the first constructed. A mould of brass was made and a quantity of the type was cast before the close of the year 1832. The rest of the machinery, except a single-cup battery and a few yards of wire, and the train of wheels of a wooden clock, which I adapted to the service of unrolling the strip of paper, I was compelled, from the necessities of my profession, to leave in the condition of drawings until I found some more permanent resting place. From November, 1832, until the summer of 1835 (two and a half years) I had changed my residence three times, and was wholly without the pecuniary means for putting together and embodying the various parts of my invention in one whole. But in July, 1835, I took possession of my new home in the new building of the New York City University, and I then lost not a day in collecting the parts and putting into practical form the first rude instrument which was to demonstrate the operation of the invention. I was favored with a little leisure from the unfinished condition of the University building, which impeded the access of visitors to my apartments for my usual professional duties.

I ought here to say that, with the aid of a single-cup battery, as early as 1834, previous to my removal to the University, I ascertained that no visible effect was produced upon numerous salts, which I submitted to trial, by putting them in simple contact with the wire charged with electricity, as shown in the plan of Fig. 1, proposed for experiment on board the ship. I succeeded, however, in marking by chemical decomposition, when the electricity was passed through the moistened paper or cloth, in 1836, in the University, but the process was attended with so many inconveniences that it was laid aside for the moment, not abandoned, that I might give my attention more directly to the electro-magnet mode of recording.

If my nomadic mode of life for two years previous and the condition of my pecuniary means be kept in mind; if, also, it be considered that many of the mechanical facilities in New York, so abundant at the present day, for embodying the invention, did not exist, and therefore were denied to me, it will account both for the slowness in completing the instrumentalities of my invention and the rudeness of the first constructed instrument. The electro-magnet was not an instrument found for sale in the shops, as at this day; insulated wire was nowhere to be obtained, except in the smallest quantities, as bonnet-wire of iron wound with cotton thread Copper wire was not in use for that purpose, and was sold in the shops by the pound or yard at high prices and also in very limited quantities.

To form my electro-magnet, I was under the necessity of procuring from the blacksmith a small rod of iron bent in horseshoe form; of purchasing a few yards of copper wire, and of winding upon it by hand its cotton-thread insulation, before I could construct the rude helices of the magnet. I had already purchased a cheap wooden clock and adapted the train of wheels to the rate of movement required for the ribbon of paper.

I needed a proper support for the machinery on which to arrange the various disconnected parts. A stretching-frame for canvas, *XX*, Fig. 4 (having a bar across the middle), which stood unemployed against the wall of my atelier, suggested to me a rough but convenient method of putting into operation the printing or marking of the signs. I nailed it at the bottom against the edge of a common table. Across the lower part of the frame I constructed a narrow trough to hold three narrow cylinders of wood, *A*, *B*, *C*; *A* and *C* small, one on each side of the large cylinder *B*. The wooden clock, *D*, was placed at one end of this trough. The small cylinder, *C*, next to the clock, had a small pulley-wheel fixed upon its prolonged axis, outside the trough; a similar pulley-wheel was fixed upon the prolonged axis of the slower wheels of the train of wheels outside the clock; these two pulley-wheels were connected by an endless cord or band.

Upon the other small cylinder *A*, on the other side of cylinder *B*, was wound the ribbon of paper, composed of long strips of paper pasted together, end to end. When the clock-train was put in movement the ribbon of paper was gradually unrolled from its cylinder, and, passing over the cylinder *B*, was rolled up upon the cylinder *C* by means of the cord and pulleys. To give the weight which moved the clock-train a sufficiently long space in which to fall, a long rod or strip of wood projecting upward was nailed to the side of the frame, at the top of which rod was a pulley-wheel over which the cord attached to the weight *E* was passed.

Upon the middle of the cross-bar of the frame there was a small shelf or bracket *h* to hold the electro-magnet, which was the moving power of the marking or printing lever.

The lever was an A-shaped pendulum, *F*, suspended by its apex at *f* from the center of the top of the frame, di-

STATUE IN CENTRAL PARK, NEW YORK.

rectly above the center of the cylinder *B* in the trough below. This lever was made of two thin rules of wood meeting at the top *f*, but opening downward about one inch apart, and joined at the bottom by a transverse bar (which was close to the paper as it moved over the large cylinder), and another about one inch above it. Through the the center of these two bars a small tube or pencil-case *g* was fixed, through which a pencil loosely played. The pencil had a small weight upon its top to keep the point in constant contact with the paper ribbon. Upon the lever directly opposite to the poles of the electro-magnet was fastened the armature of the magnet, or a small bar of soft iron *h*. The movement of the lever was guided by stops on the frame at the sides of the lever, permitting to it only a movement forward to, and back from, the magnet; the

pencil at the bottom of the lever was thus allowed to advance when the magnet was charged, and to retreat when discharged, about one-eighth of an inch. The lever advanced by the attraction of the magnet, and retreated by a weight in the first attempts, but immediately afterward by the action of a spring.

The first voltaic battery or pile[1] was of a single pair, *I*, having one of its poles connected by a conjunctive wire with one of the helices of the electro-magnet, and the other pole with one of two cups of mercury, *K*; a conjunctive wire connected with the other helix of the magnet. The only part of the voltaic circuit not completed was between the two cups of mercury, *J* and *K*. When a forked wire upon the lever, *OO*, united the two cups, *J K*,

FIG. 1.

the circuit was complete, the magnet was charged, the armature, *h*, was attracted, and the lever, *F*, drawn toward the magnet. When the forked wire was removed the magnet was discharged and the spring brought back the lever to its normal position. When the clock-work was put in motion, the ribbon of paper was drawn over the large cylinder, *B*; from the cylinder, *A*, the pencil, *g*, on the lever being in constant contact with the ribbon of paper, traced a continuous line lengthwise with the ribbon. When the lever was in a normal position, the line was upon one side of the ribbon, as at *r*; when attracted by the magnet to the other limit of its motion, the line was on the other side, as at *s* in Fig. 5.

The pathway of the pencil point (when the lever was attracted toward and held by the magnet for a longer or shorter time, tracing the line, *s*) contains the three elements of points, spaces, and lines forming by their various combinations, the various conventional characters for numerals and letters. The other line, *r*, traced by the pencil when the lever is in its normal position, may, therefore, be disregarded. Only the variations in the line *s* traced by the pencil when the magnet is charged is of importance. A specimen of these combinations is exhibited in Fig. 6.

A is the line *r* in the Fig. 5 which the pencil traces when the lever is in its normal position.

B is the line *s* in the same diagram which is to contain the conventional characters to be read as if marked in points,

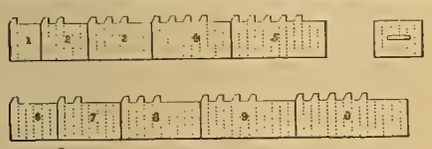


FIG. 2.

spaces and lines, as on the line *C* below the ribbon of paper. The arrows show the direction of the movement of the ribbon of paper when the clock-work is in motion.

Supposing the ribbon of paper in motion while the magnet is not charged, and the pencil to have commenced marking the upper line at *A*, when arriving at *D*, the circuit is quickly closed and opened again; the pencil is thus drawn a moment to the lower line *B*, marking a transverse across and back again, leaving a point in the lower line *B*. But as the ribbon of paper is in motion, the transverse line back again does not return the way it came, but goes back to *e*. From *e* to *f* is a space. If the circuit is closed twice and at each closing be opened quickly again, there will be two points left in the line *B*, followed by another space; if three times, there will be three points, and then a longer space, and so on, making one or more points and spaces at pleasure. But if, instead of opening the circuit quickly, it be kept closed a moment and then opened, the pencil leaves a line on line *B*, as at *F G*. Thus points, spaces and lines are made at will. Combinations of these (strictly speaking, broken parts of a continuous line) I made a sufficient variety to form my conventional alphabet. See Fig. 7, page 261.

At the time of the construction of this first telegraphic instrument, I had not conceived the idea of the present key manipulator dependent on the skill of the operator, but I presumed that the accuracy of the imprinting of signs could only be secured by mechanical mathematical arrangements and by automatic process. Hence the first conception, on board the ship, of embodying the signs in

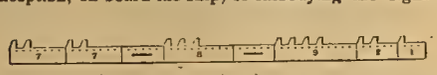


FIG. 3.

type mathematically divided into points and spaces. See Fig. 2. Hence also the construction of the type-mould and castings of the first type, in 1832.

Having ascertained that the machinery I had constructed, rude as it was, would move the ribbon of paper at a regular speed, and that the pencil lever was obedient to the closing and opening of the circuit, the next thing to construct was the manipulator or regulator of the closing and opening of the circuit.

I had already in abundance the type cast in 1832. These were now to be put in use.

I prepared rules or composing sticks *M*, Fig. 4, of about three feet in length each, formed by two strips of wood, so placed side by side as to leave a narrow channel large enough to contain the type in desired order, and to allow the cogs of the type to project above the upper edge of the rules. Through and along the bottom of the rules, projecting downward, were several needle points about one fourth of an inch in length; their use will be perceived presently.

A long trough, *L L*, Fig. 4, sufficiently wide to allow of easy passage of the rules through its length, was constructed with the following parts: Near each end of this trough were two small cylinders of wood, *L L*. On the prolonged axle of one of them was a hand-crank, and over the two cylinders an endless band of worsted tape about one and a half inches in width, which, when the crank was turned, passed from end to end of the trough. Midway and across the trough was erected a small frame or bridge, *N*, within which a wooden lever, *O O*, was suspended parallel with the endless band, having its fulcrum at *N*, at a point about two-thirds its length, but the longer part reaching from the fulcrum to the end of the trough, on each side of which, under the end of the longer part of the lever, were placed the two cups of mercury, *J K*. Upon the end of the lever and above the cups of mercury was fixed a forked wire, so bent as to connect both cups when the end of the lever was depressed, and to disconnect them when it was raised. At the other or shorter end of the lever a weight, *P*, overbalanced the longer part, and, on the under side, beneath the weight was a beveled tooth projecting downward. The rule or composing stick, having the type set up, was then placed upon the endless band; the needle points beneath the rule striking through the band and retaining the rule in its place. By turning the crank the rule was made to pass beneath the lever. The first cog of the type coming in contact with the tooth beneath the weight of

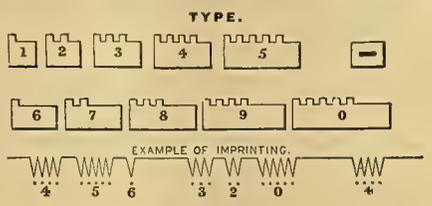


FIG. 3A.

the lever, raised that end and depressed the other, causing the forked wire to descend into the two cups of mercury and closing the circuit. When the cog had passed the tooth, the weight caused the tooth to fall into the space between the first and second cogs, and the fork at the other end of the lever to rise out of the cups of mercury, opening the circuit. At each dip of the fork into the cups, the circuit was closed and the magnet was charged, the armature on the pendulum lever was attracted and the pencil passed from the upper line *A* (Fig. 6) to the lower line *B*. When the fork was raised out of the cups, the circuit was opened, the magnet was discharged and the pendulum lever with its pencil resumed its normal position by the action of the spring. A repetition of this process, as the rules with the type passed beneath the tooth on the lever, completed the action of the instrument.

This was the construction and mode of operation of the first recording instrument for imprinting characters at a distance. In this shape it "produced a new practical result, seen and felt and appreciated by the senses," witnessed and testified to by many witnesses as seen in operation in 1835, 1836, 1837. It was undoubtedly an imperfect instrument, but it produced then the same result that is produced more effectively by more perfectly made instruments at this day. It was a result never conceived nor accomplished before; it was an important practical result for the first time attained.

The recording instruments throughout the world at this hour have the same characteristics as this first rude instrument.

They record or imprint conventional signs, points,

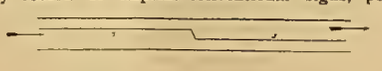


FIG. 5.

spaces and lines upon a ribbon of paper, moved by clock machinery, and by the action of an electro-magnet, charged and discharged through the agency of electricity by means of a single circuit of conductors. The mechanism of to-day is indeed more beautiful, more finished, more exact, and as varied in form as the varied forms of the timepiece. The result is consequently more rapidly produced, but the result is the same as in this original instrument. The semaphore was then transmuted into a telegraph. The evanescent sign had become fixed, permanently written or imprinted at a distance.

I have said that the modern instruments have the same characteristics as the first instrument.

To make clear the identity of the modern recording instruments with this recording instruments of 1835, which at first blush may not be so obvious, I have made the diagrams shown in Figs. 8 and 9.

As in the timepiece there is seen every variety of form and arrangement of parts to produce the same result (the passage of time), so in the recording instruments of the present day there is the same variety of form and arrangement of parts to produce the writing or imprinting, the final result in all.

Compare Figs. 8 and 9 with Fig. 4. The letters in each diagram refer to similar parts in each, so that, in describing one, all are described. In Fig. 8 the machinery that moves the ribbon of paper is removed in order the better to show the writing or recording apparatus. *F* is the lever; *f* its fulcrum; *h* the armature of the electro-magnet affixed to the lever; *m* shows the stylus or marking instrument in Figs. 8 and 9, affixed to the extremity of the lever, having the fulcrum *f* between the stylus *m* and the armature *h*. This is the modification in the modern instruments, while in Figs. 4 and 9 *g* shows the stylus affixed to the other extremity of the lever *F*, having the armature *h* between the stylus *g* and the fulcrum *f*. If, therefore, as in Fig. 9, two ribbons of paper are put in movement, one before each stylus *g* and *m*, it will be seen that *g* in Fig. 9 makes the zigzag marks represented in Fig. 6, like those of *g* in the original instrument, Fig. 4, while at the same time, by the same movement of the lever, the stylus *m* at the other extremity of the same lever marks the alphabet in points and lines or dots and dashes upon its own ribbon of paper, the characters in universal use at the present day.

It is thus preceived that, by prolonging the lever of the modern modification of the recording instruments beyond the armature *h* toward the cylinder *B*, and affixing a stylus, pen or pencil *g* on its extremity, and allowing it to be in contact with the moving ribbon of paper, as in the original instrument of 1835, the action of the lever *F* may be made to mark the original zigzag characters at *g*,

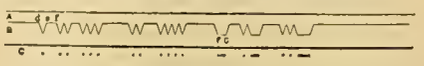


FIG. 6.

while the modern points and lines are at the same time marked by *m* on its own ribbon of paper. The dotted lines shadow the original A-shaped lever of Fig. 4, showing the same assemblage and arrangement of parts as in the original instrument.

It may seem singular to some that the plan of direct up-and-down movement of the lever, as in Figs. 8 and 9 at *m*, to mark upon the paper (the plan devised on board the ship, and which is now the most universal), should not have been the first that was put in operation, since, too, it was the first and the obvious mode devised. Having chosen, however, for economical reasons, the stretching-frame as the most convenient support at hand for the machinery, it was necessary to adapt the parts to this choice, even if my results must be attained in a more indirect manner.

It is easy to see that the direct action of the lever, as at present universally used in the register, would accomplish the result better, and it was put into use almost immediately after the first trial. Lightness in the lever was a desideratum, and this seemed to be easiest attained by suspending it at its fulcrum *f*, but, especially as a pencil was chosen as the first marking instrument (Fig. 10) it was supposed to be necessary in some way to avoid the direct blow of the pencil upon the paper, which was produced by this mode, but which endangered the point, and therefore the zigzag sliding movement was adopted. The pencil as employed in Fig. 9, at *g*, was not the only marking instrument devised and put into operation in the earlier instruments. Besides the direct action of the pencil, as in Fig. 10, fountain pens of various kinds, one of which is shown in Fig. 11, and a small printing wheel, as shown in Fig. 12, were used, the latter being supplied with ink from a sponge with which it was in contact. All these were used with more or less of success.

The same result, however, to wit, recorded characters representing numerals and letters, and words and sentences, was given by each of these modes in this first constructed

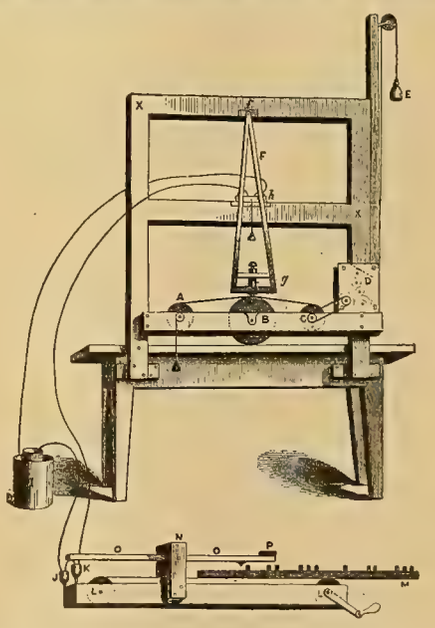


FIG. 4.

instrument as is given in instruments of the present day. The instrumentalities are the same, and the result the same; the only difference is in the mode of using the marking lever.

It will now be perceived that my invention of 1832 had certain very important novel characteristics which distinguished it from all inventions of a previous date. It was not like any of them.

Although the contemplation of static electricity as a means of producing a permanent record at a distance gave rise in my mind to the conception of the invention on board the ship, it was not the static form of electricity, but its dynamic form, which I immediately adopted for carrying into operation what I had devised. Electricity was proposed to be used by me neither in the form nor for the purpose nor by the same instrumentalities as were proposed in the earliest contrivances, say previous to the year 1800. None of them proposed to record their intelligence. None of them proposed or made use of the electro-magnet, for it was not then invented, nor the scientific

1. I had at this time a Cruikshanks battery of twelve pairs, but so out of order as not to be available for experiment.

basis of it discovered. None of them had invented a system of signs adapted to recording, for the necessity for them had not arisen. For the same reason none had proposed a moving ribbon of paper for receiving the record. None proposed to use a single circuit of conductors.

In the earliest attempts to use electricity for communicating at a distance, static electricity was the form proposed and attempted. Failure was the uniform result, not for the lack of ingenuity in the savants of that day, but from the intractable nature of the form of electricity to which they were limited. When the dynamic form of electricity became known, it was at once seized upon as an agent in accomplishing communication at a distance.

Still, between the years 1800 and 1832, the means by which that end was to be accomplished were all semaphoric. Decomposition by dynamic electricity in the form of gas bubbles and the deflection of the magnetic needle, were the sole novelties in the signals of their proposed plans. No period, therefore, is more strongly isolated from all previous dates than the date

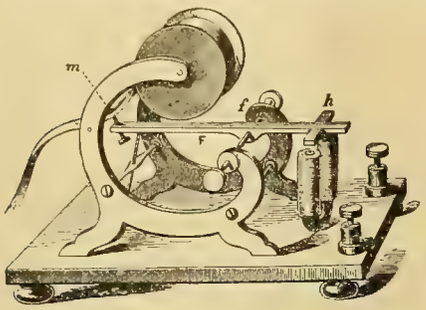


FIG. 8.

1832 as the epoch of a new method of applying electricity by the electro-magnet to the creation of a new art, of a new method of communicating to a distance, to-wit, recording a method wholly unlike any previously imagined or invented.

But the instrument I had devised in 1832 and constructed in 1835 (so far at least as to demonstrate its practibility to communicate from one station to a distant station) did not completely embody my whole plan. This whole plan was not complete until I could, by a duplicate of the instrument, have the means of a return from that distant station. This was necessary, in order to receive from, as well as to send to, a particular station. The whole plan comprised inter-communication, or reciprocal communication.

It is true that any ordinary mind could easily comprehend from the operation of the single original apparatus that, if precisely the same apparatus were used from the receiving station to the sending station, inter-communication would be complete. No new appliances were necessary. A duplicate of the instrumentalities already in use from the sending station to the receiving station was all that was needed to complete my whole plan, and to establish intercommunication. But this was an affair of finance and not of invention. To supply the duplicate required pecuniary means, and these I had not at command. But the rigidly captious may ask, "Why did you not borrow the pecuniary means?" My reply must be that I preferred the delay and the hazards of a delay to the hazard of being unable to repay a loan. I must be pardoned if I state that, even from my earliest youth, I ever had the deepest repugnance to incur debt by borrowing, even from my own relatives. Is it my idiosyncrasy? If so, the reader will excuse it, and my allusion to it.

By dint of the most rigid economy, I was able slowly to complete and to add this duplicate, necessary to complete my whole plan. Although the original single instrument was freely shown to my pupils and to many friends, I was reluctant to make any more public exhibitions of the invention until this duplicate should be added, and this was

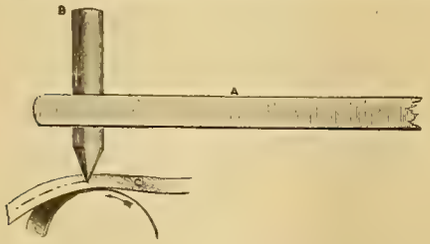


FIG. 10.

done in the early part of August, 1837. Early in September I was more free in exhibiting the invention, and on the second and on the fourth of September I showed the instruments in operation to some hundreds of persons assembled in the large hall of the University. Most writers on the telegraph choose to take this date as the date of my invention. But why, with the facts before them, is this just? To the existence and previous operation of the essential part of my whole plan, long before this more public operation of 1837, there were many witnesses whose evidence is before the courts on oath. But there are other writers, having ascertained the date of my caveat at the Patent Office on the 6th of October, 1837, and others again who find the date of the 7th of April, 1838, the date of my application in Washington for letters-patent, who choose to consider this latter date, as the date of my invention. To all these I propose a question. Suppose I had never applied for letters-patent for the invention, but had chosen to give it to the public, or suppose I had never brought it to France, would there, therefore, be no invention, and no inventor of it? Their answer will settle that point.

Between the date, 1835, of the completion of the first instrument and 1837, the date of its more public exhibition, there was a very important addition to it, which I had already devised and provided against a foreshadowed exigency, to meet it, if it should occur when the conductors were extended, not to a few hundred feet in length in a room, but to stations many miles distant. I was not ignorant of the possibility that the electro-magnet might be so enfeebled, when charged from a great distance, as to be inoperative for direct printing. This possibility was a subject of much thought and anxiety long previous to the year 1836, long previous to my acquaintance or consultations with my friend, Professor Gale, on the subject, but I had then already conceived and drawn a plan for obviating it. The plan, however, was so simple that it scarcely needed a drawing to illustrate it; a few words sufficed to make it comprehended. If the magnet, say at twenty miles distant, became so enfeebled as to be unable to print directly, it yet might have power sufficient to close and open another circuit of twenty miles farther, and so on, until it reached the required station. This plan was often spoken of to friends previous to the year 1836, but early in January, 1836, after showing the original instrument in operation to my friend and colleague, Professor Gale, I imparted to him this plan of a relay battery and magnet to resolve his doubts regarding the practicability of producing magnetic power sufficient to write at a distance.

This apprehended difficulty of an enfeebled magnet, as distance increased, was among the very first subjects of discussion with Professor Gale. So soon as my plan for obviating it was revealed to him it was deemed perfectly satisfactory. It was not then permanently embodied for use. A moment's reflection will show why. The relay was not then necessary to show the final result of the telegraph in the short circuit of less than a mile arranged around a hall. The operation and result of printing at a distance was complete without it. But the frequent objection made by visitors that the instrument shown them might answer well enough for an interesting philosophical experiment in a class-room, but would not operate at a distance, at length induced me not merely to explain the relay by words and figures, but so soon as I could command another magnet to embody it in proper form.

This plan of the relay thus made in the spring of 1837 was productive of an important incident of great consequence to me in the prosecution of my invention. A few days after the more public exhibition of the telegraph, the late Alfred Vail, Esq. (then a student in the University,

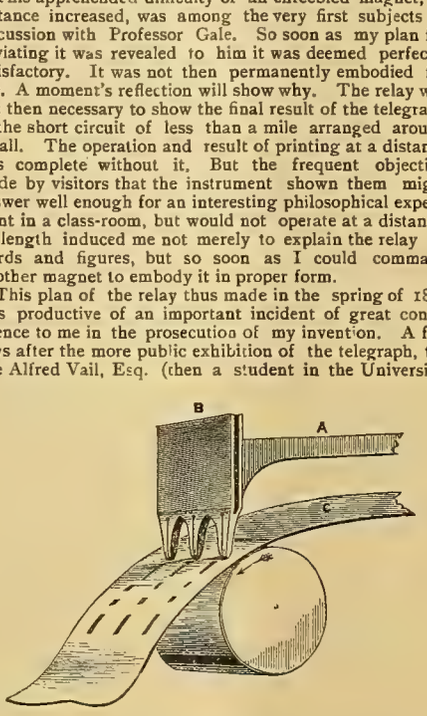


FIG. 11.

who was present at the exhibition on the 4th of September) became so fascinated with the invention that he called to have it more perfectly explained to him. The usual objection that it would not operate at a distance was a bar to his belief in its success. No sooner, however, had I explained the operation of the relay than he desired an interest in the invention, and to procure this interest, he offered to negotiate with his father and brother to supply the funds necessary to have constructed such a telegraphic instrument as would demonstrate to the United States Congress and to the country its practicability and utility. Thus the invention of the relay was the immediate cause of the construction of the apparatus which was shown to Congress in Washington in the winter of 1837-1838.

The simple and effective instruments as modified by Messrs. Digney Freres of Paris, embody the distinctive feautures of my invention more to my satisfaction than any of the French instruments. There is a modification which they have made' however, which requires a few remarks to prevent misapprehension in regard to its exact nature. In reading the excellent work of M. Brequet, p. 163, in his chapter "Morse Register Marking the Signs in Ink," "Recepteur Morse Faisantles Signaux á l'Encre," I find some things to correct. A wrong impression is made in describing the mode of embossing the characters by a steel point, "á gaufrage," as if that were my only original mode of marking. This is not the fact; a pencil, a fountain pen, and the small printing wheel by which ink was used, were among the first modes of marking. There were many modes of marking which I devised and tried, but experience alone could settle which was best; the pencil and pen and small printing-wheel with ink were the original modes in use; the steel point, Fig. 13, for embossing the character, was invented some time after, and patented as an improvement, since it dispensed with ink; M. Brequet gives to Thomas John of Prague the invention of the small printing-wheel "une molette ou rouiette," to mark the characters, and states that he received for his invention a platina medal from the Society of Encouragement.

That Mr. Thomas John made his improvement independently, without a knowledge of the fact that I had it in use nearly twenty years before, I have no doubt, but it is nevertheless true that the introduction of this inking wheel is not a novelty; whatever of novelty there is in its present use consists in the mode of its application, and in the beautiful apparatus constructed by Messrs. Digney Freres the mode, so far as I know, is new. The mode of application of Mr. John is different from mine and from Messrs. Digneys'. My original mode (its first use) was by bringing down the printing-wheel, inked from a sponge upon the paper. Mr. John brings the printing-wheel against the paper from the side.

My caveat, filed in the Patent Office in Washington on the 6th of October, 1837, in describing the register specifies: "3. A pencil or fountain pen or a small printing wheel, or any other marking material;" and the mode of using the wheel is also described thus: "When the printing wheel is used, the wheel is brought in contact with the paper by the magnet when required to mark." The wheel in my first experiments, inked by a sponge, was brought down upon the paper; Mr. John's mode of applying the wheel inked in a reservoir was by bringing it against the paper from the side, while Messrs. Digneys' mode was bringing the paper against the wheel inked by a felt roller. This latter mode I conceive to be a substantial improvement, since it

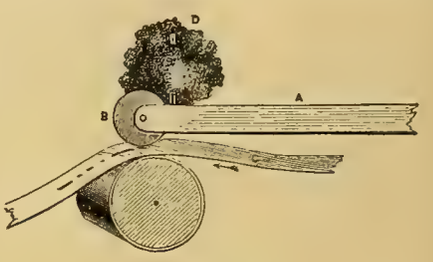


FIG. 12.

combines delicacy with efficiency, and requires so much less power for the operation that even the relays can be dispensed with on lines of considerable extent. My original mode of using the printing-wheel by ink from a sponge, I found so convenient, from its constant tendency to soil the paper, and the fountain pens of every variety of form so unreliable, that the steel point, 'á gaufrage," Fig 13 I considered at the time a great improvement, since it gave the characters with certainty, without the inconvenience of constant attention and the dirt and accidents of the ink.

If, then, judged by the first rule laid down by Dr. Russell, I claim to be the inventor of the first recording telegraph (not to say, strictly speaking, the first real telegraph) am I not "the first who produced the practical result, which, however imperfect, gave a result which was seen and felt and appreciated by the senses?" Am I not, according to this rule, "the true maker and inventor whom the world should recognize, no matter how much may have been done by others to improve my work"?

Let me not be misunderstood as appropriating to myself the credit of the many modifications of the telegraph that have since been made in every part of the world, because I claim the invention of the generic telegraph. I do not pretend that the mechanism of the first forms of the telegraph was not rude, and even uncouth, when compared with the beautiful workmanship of the European ateliers, of the hundreds of accomplished mechanicians who have brought to the work their incomparable ingenuity and skill, but I think I may justly claim that the essential characteristics of a new art were demonstrated even in the rudest instruments, constructed in the earliest times of the invention. So suggestive were the novelties introduced by the promulgation of the new art, so wide the field which it opened for investigation in science and mechanics, that it would be strange indeed if modifications of the separate elements that made up the whole invention should not at once be conceived and produced. And yet I may appeal to the fact generally acknowledged that the essential features of the original invention have not been obliterated; they can be easily and distinctly traced through all the improvements made

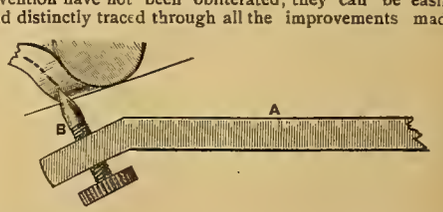


FIG. 13.

in the various parts by which the different processes of the art have been more easily performed.

Seeing by Electricity.

William E. Curtis, the well-informed correspondent of the *Chicago Record*, prints the following bit of news in a recent Washington letter:

Prof. Alexander Graham Bell is spending these months at his summer place in Nova Scotia, engaged in a series of investigations which will no doubt have important and perhaps sensational results. His outdoor work is devoted to experiments in "aerial navigation," in connection with Prof. Langley of the Smithsonian Institution, while in his laboratory he is endeavoring to demonstrate a problem to which he has given a great deal of thought, and in which he thoroughly believes. It is to harness electricity to light, as it has been harnessed to sound, so that people may be able to see a great distance, just as the the telegraph enables them to write and the telephone enables them to speak at a great distance. Prof. Bell firmly believes that it will be possible some day to see from Washington to New York as easily as one can convey the sound of the

voice that distance. He insists that the fact has already been demonstrated and that it only remains to construct the apparatus necessary to bring the possibilities of the discovery into actual and practical use. This is excedingly difficult—much more difficult than the construction of the telegraph instrument or the telephone, for the reason that the vibrations of light are so much more rapid than the vibrations of sound. But Prof. Bell is confident that he will soon be able to discover a diaphragm sufficiently sensitive to receive the vibrations of light and, produce the effect necessary to convey the impressions to the human vision.

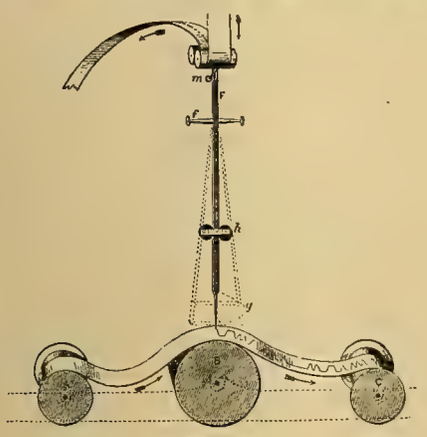


FIG. 9.

Lamp Lighting Schedule.

Following is the WESTERN ELECTRICIAN'S moonlight schedule for June:

Day of Month.	Light.	Day of Month.	Extinguish.	Number of Hours.
	H.M.		H.M.	H M.
1....	P. M. 8.00	2....	A. M. 3.30	7.30
2 ..	" 8 00	3....	" 3.30	7.30
3....	" 8.00	4...	" 3.30	7 30
4 ...	" 8 0(	5...	" 3.30	7 30
5...	" 9 10	6....	" 3.30	6 20
6 ...	" 9 50	7....	" 3.30	5 40
7 ...	" 10.30	8 ...	" 3.3(	5.00
8 .	" 11.00	9 ..	" 3.30	4.30
9 ..	" 11.2)	10....	" 3.30	4.10
10....	" 11.4(	11....	" 3 30	3.50
11 ..	" 12 00	12....	" 3.30	3.30
12 ...	A. M 12 20	13 ..	" 3 3(	3.10
14 ..	" 12.4	14....	" 3 30	2.50
15....	" 1.1(	15...	" 3.30	2 20
16....	" 1 4	16....	" 3 30	1.50
17...	No light.	17....	No light.	0 00
18....	No light.	18 ..	No light.	0.00
19....	No light.	19 ..	No light.	0.00
20 ...	P. M. 8.1(	20....	P. M. 11 0	2.50
21....	" 8.1(	21...	" 11.3(	3 20
22 ...	" 8 10	22....	" 11.50	3.40
23....	" 8.1(	24 ..	A. M. 12.10	4.00
24....	" 8 1(	25....	" 12 30	4.20
25 ...	" 8.10	26 ...	" 12.50	4.40
26 . .	" 8 1(	27 ..	" 1.10	5.00
27 ..	" 8 10	28 ...	" 1.30	5.20
28....	" 8.10	29 ...	" 2.00	5.50
29....	" 8.1(	30....	" 2.30	6.20
30 ..	" 8 4(	July 1	" 3.20	6.40
		Total.....		125.10

The foregoing schedule was calculated on the following basis:
Light one-half hour after sunset and one hour before moonset.
Extinguish one hour after moonrise and one hour before sunrise.

The Kinetoscope in Chicago.

Ten kinetoscopes are on exhibition in Chicago at 148 State street. These machines are the complement—what may be termed the public end—of the kinetograph, Edison's recent and widely heralded invention. The kinetograph, in the perfection of which Edison was greatly assisted by Walter K. L. Dickson, is, essentially, a machine for taking a large number of photographs in a short space of time on a sensitive film. This ribbon of film, imprinted with a series of photographs of any event, taken with almost incredible rapidity, is then transferred to the kinetoscope, and, by means of an electric motor, drawn before the eyes of the spectator (who looks in a cabinet through a glass-covered aperture) with such speed that 46 distinct views pass by each second. The eye is unable to retain separate impressions at this rapidity, and the pictures thus blend together, giving life-like motion to the figures and objects portrayed. The scene thus becomes animated and dramatic and gives the same effect as though the motion had been actually photographed. The kinetograph has not been seen outside of Edison's laboratory, but the kinetoscopes are on exhibition in New York and Chicago. The latter do not present any electrical novelties; the principle of the kinetograph is a marvel of photography, and is not electrical. Each kinetoscope is supplied with an eight-volt motor to revolve the film rollers and an especially constructed eight-volt incandescent lamp for throwing light on the pictures. By throwing one switch both the motor and lamp are cut into circuit, and the machine runs thirty seconds, during which 1,380 views pass before the eye, and are blended into one animate picture. Eight amperes of current is required, obtained from 20 cells of American storage battery, wired four in series. The batteries are charged from a 110 volt circuit on the premises. The kinetoscopes are sold outright by the International Novelty company, which will make Chicago its headquarters and of which Norman C. Raff is president. The local office is in charge of Jesse Parker, and the machines were installed by A. Holland, one of the foreign agents. For some time the novelty will be on exhibition for a small fee. There are ten views portrayed, as a scene in a barber shop, a blacksmith's forge, wrestlers, etc. The best is a representation of a cock-fight, which is very spirited.

Engine Regulaton in Arc Lighting.

While regularity of engine and dynamo speeds is a generally recognized necessity for incandescent electric lighting systems, says a writer in *Cassier's Magazine*, it is often assumed that arc lights do not require it. This, however, is a decided fallacy. The resistance of an electric arc varies continually. It is instructive to put a single arc lamp in circuit and then watch the index of an ammeter. This will seldom or never be quite at rest. If the carbon

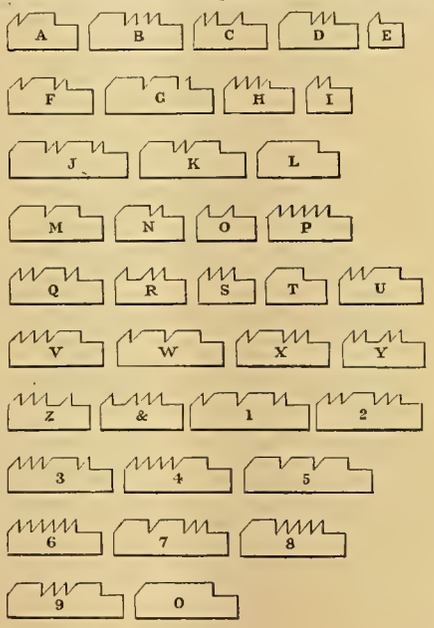


FIG. 7.

be a bad one, the index will jump through comparatively large ranges, each splutter of the lamp being attended by a jump. When there are a number of lamps in series, a little overfeeding or a little underfeeding of the carbons may considerably alter the resistance, and, unless there be a reserve of power and a good governor, the result will be unsatisfactory. If a little overfeeding take place, the resistance will be diminished, the quantity of current flowing will be increased and more load thrown on the engine. If the latter be properly governed, its speed will be kept constant, and the lamps will have a chance of recovering themselves; but if, on the contrary, the speed should fall off, the lamps will get worse and worse.

Cities Not Responsible for Accidents from Trolley Poles.

The city of Lansing, Mich., granted to a street railway company the right to lay its track and erect its trolley poles along a certain street. The track was laid along the east side of the traveled portion of the street, and the trolley poles were placed in the gutter outside of the way intended for travel. A passenger, while riding upon one of the street railway company's open cars, which are wider than the ordinary car, and while standing upon one of the sideboards used as steps, came in contact with one of the trolley poles and was injured. He sued the city, alleging that the trolley pole was an obstruction in the street. The Supreme Court of Michigan sustains, in Kennedy vs. City of Lansing (58 Northwestern Reporter, 470), the decision of the circuit judge that for such an accident the city is not responsible. The municipality, it says, did not fix or direct the precise location of the tracks or of the trolley poles or determine the width of the cars. The tracks, cars and poles are the property of the company, and incidents of that particular system of transportation, as virtually so as are the horses, harness and vehicles of other systems. If an injury is inflicted upon a passenger by a defect in a rail, or by reason of an improper adjustment of that system, the city can be no more held than if a passenger in an omnibus is injured because of the breaking of a defective axle, or because the horses were hitched too long or too short. The injury in the present case was not occasioned by the condition of the street, but by an improper arrangement of the appliances employed in a method of its use. Respecting the liability of the city, the case is the same as if the passenger had been injured by contact with a car on a parallel track of a double track system. Municipalities are in no sense responsible for the adjustment of the parts of this mode of transportation. They may, by the exercise of police power, prohibit such an adjustment as would endanger life, but the failure to exercise that power would not render them liable to respond in damages; nor would the exercise of a prohibitory ordinance, its violation and consequent injury involve them in liability. They are, of course, bound to see that the construction of tracks in streets does not necessarily interfere with or endanger other uses of such streets, but they are not insurers of street car passengers against defects in the street car system itself.

Electric Locomotive Headlights.

The steam railroad journals of the country appear to be agreed that the substitution of electric for oil headlights on locomotives should be encouraged. The *Railway Review* has this to say on the subject:

The difference between running with and without an electric headlight is that an engineer can by looking out of his cab window know whether his train is in danger, while with the ordinary headlight he is making a plunge in the dark and taking it for granted that the track is clear. There are so many risks necessarily incurred in the operation of railroads as to make it imperative that such as may be avoided shall be, and in a degree at least the danger from obstruction on the track at night is one of this kind. Where electric headlights have been used and the engineers have been accustomed to them, they say they are afraid to run without them, and a few rides on engines, first with one light and then the other, will lead any one to the same conclusion. One of the strong points of the electric light is that with it signals and targets can be seen as readily at night as during the day, and, therefore, should a single light at any time be extinguished or the glass broken so as to give a wrong signal, there is no danger of an accident, as the signal is still effectually given. Some roads have gone so far as to do away with all switch lights and depend entirely on the electric headlight for distinguishing the position of the switches, and find it satisfactory in every way.

A Fish Story.

What electricity is doing and will do for table decoration is foreshadowed, according to the veracious *New York Times*, in an account of a recent feast, where a dish of jelly was illuminated by an electric light shining through the mass. The effect of this dish, set in flowers and protected by a silver cover till the moment of exposure, is very striking and original. The use of minute electric batteries is making most startling effects possible.

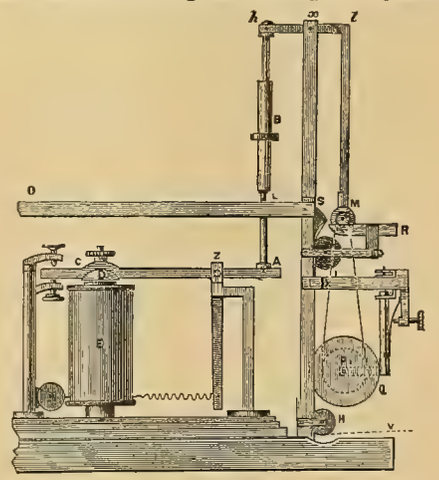


FIG. 14.

Jewels, flowers and food can be lighted up in remarkable and very effective ways. Even the illumination of gold fish was possible to the wizard, Edison, who set them in a little table as an ornament, and having got them to pond swallow tiny electric lamps connected with a dynamo by an almost invisible wire passing from their mouths, they flashed about brilliant and resplendent.

Some experiments have been made on a telephone line formed by coupling to one another the Trieste-Vienna-Prague-Reichenberg-Zittau-Berlin lines, a total distance of some 600 miles, when it was found that although a melody was easily transmitted, speech was not very distinct. The experiments are considered to be so promising as to raise afresh the question of the advisability of telephonic communication over this route.

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THE dominant faction of the Institute is resourceful and diplomatic, and we cannot refrain from extending our congratulations upon the skill displayed in the management of the last campaign. The gentlemen comprising the coterie in control have not only perpetuated their own rule, but they have succeeded in deluding their old enemy, "the pioneer, etc.," and committing it to their fortunes. That was indeed a good political stroke, which silenced criticism in that quarter and secured a champion, old and decrepit though it be, but enthusiastic nevertheless, and voluble. And all, too, for a place in the council!

GOVERNOR FLOWER has vetoed the bill passed by the last Legislature of New York repealing the law of 1893 under which the superintendent of public works was authorized to grant a franchise to an electric company for the establishment, operation and maintenance of a system of electric propulsion on the canals of the state. The governor claims that the proposed bill, if permitted to become a law, would place in the hands of the Cataract General Electric company a monopoly of this business, but it is hard to see how any other state of affairs can exist in view of the contract which that company now has with the state. As a matter of fact the governor should have interposed his objection when the superintendent, a subordinate of his, contemplated making the contract. The Legislature was unable to get the bill through in time to stop this action, and a word from Governor Flower would undoubtedly have postponed the issuing of the papers. The haste displayed in granting this valuable franchise to a lot of politicians and wealthy men disgraced the administration and was enough to condemn it before the people. In view of these facts it is simply ridiculous for Governor Flower to assume the position of defender of the people's rights against a threatened monopoly.

ELSEWHERE in this issue is presented an outline of the proceedings of the eleventh annual meeting of the American Institute of Electrical Engineers, at Philadelphia, last week. Generally speaking, the gathering may be said to have been successful, though the action taken on some particular points will, no doubt, be a source of regret to many. The council ticket was elected, the report of the committee on units and standards was approved, and the programme as prepared by the management was closely followed. Much attention was devoted to social features, and it was generally agreed that in this respect at least the eleventh annual gathering of the Institute far outshone all former meetings.

Concerning the work of the meeting it may be said that the papers presented were of a high order, and that the discussion of some of the subjects was very interesting. A few of the papers were passed without any comment, and others received very little attention. This was due to the failure of the contributors to hand in their papers in time to have them printed before the meeting. This, of course, is to be regretted, and it is to be hoped that all papers presented at future meetings will be submitted in ample time to enable the members to become familiar enough with their contents to discuss them intelligently.

OCCASIONALLY the *Electrical World* of New York has an attack of hysterics, and these are always amusing; but there is really nothing quite so funny about this erratic journal as the little gems of information tucked away at the bottom of columns, where they sparkle none the less brightly because of their inconsiderable dimensions and child-like simplicity. It is here that we come across the correction of errors, an occasional anecdote of Lincoln in terms easily understood, the words-of-one-syllable account of the mathematical process involved in expressing kilowatts in horse powers, and other pleasing knowledge in a diluted form. Each little nugget has its own attractive heading and does what it can, in its simple, cheery way, to enliven the otherwise rather dull columns of the *World*. This benevolent intention is evident in the sprightly title of last week's addition to the collection, "No Wonder They Pop When They Break," and the delight of the reader is further increased by reading of the atmospheric pressure on the "bulb of a 2,000 candle power incandescent lamp." Such a lamp would undoubtedly pop when it broke, and, as the *World* intimates, that fact would not be surprising. The wonder lies in the lamp itself. From its boundless store of technical knowledge cannot the "pioneer electrical journal" vouchsafe us other tiny bits in relation to this interesting lamp and the popping thereof? We await further revelations with much interest.

IT is fitting at this time, the fiftieth anniversary of the establishment of electric telegraphy in the United States and in the world, that attention should be again directed to the career of the man to whom, more than to any other, civilization owes the magnificent impetus given by this invention. This man was Samuel F. B. Morse, and although attempts have been made to deprive him of the laurels that are justly his, his fame remains undimmed, and his name, so far as we can now judge, will go on through the annals of time as one of the world's greatest benefactors. It is true that others conceived some idea of the transmission of intelligence by electrically transmitted signals; but it was Morse who, independently, invented a practical telegraphic system; it was Morse who, despite ridicule, privation and discouragement of every kind, realized the great possibilities of his idea and persisted in forcing the world to accept its benefits; and it is the Morse system, or some modification of it, that is in use throughout the globe to-day. Surely this man was entitled to the honors that were heaped upon him during his lifetime; and a retrospective tribute at the end of the first half-century of telegraphy is none the less out of place.

The most important feature of the collection of facts bearing on the great inventor to which such a considerable portion of the WESTERN ELECTRICIAN is this week devoted, is the reprinting of Morse's own account of the invention of the telegraph. This is a most interesting story, modestly and clearly written, and will probably be entirely new to most of the younger readers of this journal and hardly less enjoyable to the small number who may have seen it before. Prof. Morse gives a vivid account of the difficulties encountered and of the method employed in thinking out and constructing the first rude instruments, and no one can fail to have a greater admiration for the man after reading this calm statement. He was one of the greatest Americans, and it is a disgrace that some lasting memorial has not been erected to his memory before this in the capital of the country, where he spent so many anxious days. A movement for a statue in Washington is now on foot, and we hope that Congress will make the necessary appropriation.

AN interesting feature of the increasing competition between the telegraph and long-distance telephone is developed by the fact that the wires of the latter have very largely replaced those of the former for private lines for stock exchange business between Chicago and New York. It is stated that between the two cities there now remain but two systems of private wires of the old sort. All the other concerns now employ the long-distance telephone wires. The telegraph companies have consequently lost all this private wire business with these two exceptions, and the telephone company has captured it all.

This is a significant indication of a perfectly apparent probability of a clash between the Western Union Telegraph company and the American Bell Telephone company, which is, of course, behind the American Telephone & Telegraph company, which operates the long distance telephone system. These two great monopolies, long working in concert by a written agreement, are now, to a considerable extent, business rivals, and the conflict of interest is every day becoming more apparent. By its activity in long-distance work the Bell company has invaded the field of telegraphic business, and this system is being constantly extended. It is difficult to see how the two companies can fail to come more and more into competition, especially as it now appears to be only a question of time when a large proportion of the press dispatches of the country, especially those sent as "specials," will be transmitteed over the telephone. The revenue from newspapers and newsgathering associations forms a very large item in the income of the Western Union Telegraph company, and it will not regard a formidable encroachment with equanimity.

Beside the volume of business already diverted to the long-distance telephone and in prospect, it must be remembered that there is nothing to prevent the Bell company from itself engaging in sending messages by telegraph if it becomes so minded. It may well be borne in mind that the name of the long-distance company—the American Telephone & Telegraph company—can hardly be deemed as conciliatory by the Western Union company. With the expiration of fundamental and auxiliary patents, competition in the local telephone business has already begun. Every important electrical supply house has a telephone outfit for sale or announces that it soon will have. Without minimizing the great advantage to the Bell company of its experience, entrenched position, capital and still unexpired patents, it will be recognized by all—and by none less quickly than the keen minds in the service of the American Bell company—that the days of telephonic monopoly are numbered. Hereafter the Bell people will have to meet growing competition in their own field, with a lessening margin of profit. What wonder, then, if the company, with the unsurpassed facilities at hand in its finely constructed long-distance lines, decide to broaden its field by combining telegraphy with telephony? The contingency is by no means improbable.

It will be seen that the situation is one of great interest and importance to the entire commercial community. Both of the great corporations that seem destined to meet in conflict are regarded with hostility by the people generally, the telephone company being perhaps more deeply disliked than its older rival. The weapons used in the fight will undoubtedly consist of reductions in rates, largely, and the public, which receives the benefit, will not feel disposed to place any obstacle in the way of the merry war, but will rather rejoice at its continuance. The rival companies understand this perfectly, but, as has been shown, the trend of events is such that it is difficult to see how the fight can be prevented. The condition of affairs is further complicated by the existence of the enterprising and well-managed Postal Telegraph-Cable company. Who can tell what its attitude will be? At any rate, the situation is full of promise to the public at large, and the opening gun of the warfare will be a welcome sound in the ears of the American people.

The Eleventh Annual General Meeting of the American Institute of Electrical Engineers.

The eleventh annual meeting of the Institute was convened in Philadelphia, the city of its birth, on Tuesday morning, May 15th, in the rooms of the Engineers' club, 1122 Girard street. The hall selected for the meetings was small, but in other respects admirably adapted to the purpose. It was provided with an excellent blackboard, an adjunct which the New York members fully appreciated, as their own headquarters were not provided with one, and for the experiments requiring it the 500 volt street railway current was brought into the building.

Philadelphia is renowned for its hospitality, and its reputation suffered nothing on this occasion. In fact, the local committee of arrangements outdid itself in that unobtrusive way which is so delightful to the recipients of attention, and which is the acme of the art of entertaining. Chairman Elmer G. Willyoung, and his efficient corps of assistants, seemed to be here, there and everywhere at the same time—that is to say, they always seemed to be on hand at the right time, and to anticipate the wants of the visitors. The early hour of meeting prevented a large attendance at the opening session, as only a small portion of the New York contingent arrived before noon. By afternoon, however, the crowd had increased, and at the afternoon session the room was full.

TUESDAY MORNING SESSION.

The meeting was called to order by President Houston, and the minutes of the last annual meeting read and adopted. The next business in order being a canvass of the votes for officers, G. R. Metcalfe and Francis R. Upton were appointed tellers, and the ballots were turned over to their care. Mayor Stuart was then introduced. In a few happily chosen words he welcomed the Institute to the city of Franklin. Of the eminent scientist, he said, that although he was not a native of Philadelphia, he had spent most of his active career there, and it was there that he had enticed lightning from the clouds. He was a great electrician in his own day, but the speaker thought no one would be more surprised at the advancement of the present day than Franklin, could he but come among us again. He hardly thought that the great philosopher would be considered an electrical engineer to-day notwithstanding he planted the seed from which grew much of that which we see around us. Franklin was not with us to-day, but the visitors could see his grave if they felt so inclined. In view of all the circumstances, he thought Philadelphia a particularly appropriate place for this meeting, and in the name of the people of Philadelphia, in behalf of his professional brethren, and as an official of the City of Brotherly Love, he welcomed the visitors to Philadelphia, and invited them to visit and criticize, if they could, the municipal electric plant, of which he and all other Philadelphians were proud.

Prof. Houston replied in an appropriate manner in behalf of the Institute and then introduced John C. Trautwine, Jr., president of the Engineers' club, who made some remarks. While the Engineers' club, he said was more general in its scope and local in its character, it embraced all branches of engineering, and claimed among its members many electrical engineers who were an honor to the club and to their profession. Speaking in behalf of the engineering profession at large, and of the Engineers' club in particular, he extended the members of the Institute a welcome to the city and to the club's rooms.

The report of council for the year ended April 30, 1894, was read by title and an auditing committee consisting of Elmer G. Willyoung and William J. Hammer was appointed, who, after examining the books, reported favorably upon them and the report was officially adopted.

The next business in order was the reading of the report of the committee on units and standards. According to this report the committee had written to the leading foreign electro-technical societies asking each for its definition of the term "inductance." In reply, one of these expressed no opinion; two defined it as the "coefficient of induction," and one defined it substantially as a watt-less resistance. The majority being in favor of applying the term to the coefficient of induction, and that being the sense in which Mr. Heavysides, who first applied the term, used it, the committee had recommended that the term "inductance" should be applied to the coefficient of induction and that it should represent a length and be expressed by the symbol L.

Mr. Steinmetz argued that it was necessary to have some term by which to express that spurious resistance which has already been defined in several ways. There were two ideas conveyed in any generic term, viz.: that of self-induction, pure and simple, and angular velocity. As long as there were two meanings to be conveyed he thought there would be less confusion by letting the matter stand as it was because then writers or speakers would be careful to state explicitly which of the two meanings they meant to convey, whereas, if a name were given to either of them there would always be a doubt as to which was meant.

Dr. Bedell endorsed Mr. Steinmetz's position, but would limit the meaning of "inductance" to self-induction alone. Mr. Kennelly, chairman of the committee on units and standards, stated that as at present used there were two entirely opposite meanings applied to the term and it was most important, since the term "inductance" was in constant use that it should be settled once for all which definition should be given to it. It had been hoped that the electrical congress would decide it, but it did not. It was to put an end to this very confusion that these letters had been written. The general feeling seemed to be that the term inductance should be defined as the coefficient of self-induction and not as a resistance as the French society held. Heavysides, who originated the term, defined it as the coefficient either of self or mutual induction. The recommendation of the committee was finally adopted.

Mr. Steinmetz then said: "Well, if the coefficient of self induction is to be called 'inductance' I would like to see the ratio

$$\frac{\text{Out of plane component of E. M. F.}}{\text{Current.}}$$

given the name 'reactance.'" This proposition was put as a motion and was seconded by Kennelly and unanimously adopted, so there is another new name to add to the already long list.

The question of the recommendation to Congress to legalize the units adopted by the electrical congress, was on motion of Carl Hering referred to the committee on units and standards.

The secretary presented invitations:

From the Bell Telephone company, extending the use of the long distance telephone to the members.

From A. Faulkner, to visit his shops to inspect the 8-inch projectile made for the Zalinski gun.

From Dr. Fetteral, to visit Girard College.

From President Stile, to visit and make use of the library of the Historical Society of Pennsylvania.

From the La Roche Electrical Works and Queen & Co., to visit their establishments.

From Dr. William Pepper, to visit the University of Pennsylvania.

From the Germantown Electric Light company, to visit its station.

From John C. Trautwine, Jr., president Engineering club, to make use of the club's quarters.

From Dr. Wahl, secretary Franklin Institute, to visit and make use of the library of the Franklin Institute.

From the Athletic club, to make use of its quarters, and from the Drexel Institute of Arts, Science and Industry, to view the institution.

The secretary announced that at the meeting of council, the following gentlemen had been elected to associate membership.

Arthur W. Berresford, B. S M. E., Brooklyn, N. Y.; Joseph Bijur, New York; Henry R. Chadbourne, Jr., Troy, N. Y.; Sumner W. Childs, Baltimore, Md.; LeRoy Clark, Jr., New York; Clarence E. Doolittle, Aspen; Colo.; Frank H. Dorr, San Francisco, Cal.; Frank W. Glading, Philadelphia, Pa.; Arthur Hartwell, Pittsburg, Pa.; Foster L. Haviland, New York; William R. Hewitt, New York; George C. Holberton, San Francisco, Cal.; George H. Morse, Excelsior, Minn.; Walter W. Nicholson, Utica, N. Y.; B. W. Philbrick, Rhinecliff, N. Y.; Charles W. Ricker, Buffalo, N. Y.; Clayton H. Sharp, Ithaca, N. Y.; Prof. Wilber M. Stine, Chicago, Ill.; George A. Tower, Richmond, Va.; Hugh M. Wharton, Newark, N. J. and Samuel B. Winchester, Holyoke, Mass.

The following named associate members were transferred to full membership:

James Grieve Lorrain, London, Eng.; Alfred E. Wiener, Schenectady, N. Y.; Henry A. Craigin, Boston, Mass.; W. F. C. Hasson, San Francisco, Cal.; Edward B. Ives, Philadelphia, Pa.

Mr. Phelps next offered a resolution to the effect that the expenses for reporting the proceedings of the Chicago meetings, not to exceed $10 per meeting, be borne by the general fund, until further notice. The resolution was adopted.

At this point the tellers asked for an interpretation of Rule V paragraph 4 of the rules which says that members must add their signatures to the voting envelopes. They reported that the names on a number of the envelopes were not autographic—some were typewritten, some embossed and others made with rubber stamps and were therefore not signatures in the strict sense. It was ruled that all such should be received as signatures.

Mr. Phelps next called up the tabled motion of revision of the election rules. The secretary having read the report of the committee on revision Mr. Phelps and Carl Hering offered amendments, which were rather additions to the proposed amendments, providing, the one that associates elected after the voting blanks were sent out should be entitled to vote and the other fixing a time when the polls should be closed, which was the hour of calling the meeting to order—whatever that might be.

There was considerable discussion on both of these motions, but they were both finally adopted, after which the meeting adjourned to reconvene at 2 P. M.

AFTERNOON SESSION.

The meeting was called to order at about 2:30 P. M. with a large attendance. It was announced that Mr. Wurtz's paper would be postponed until Wednesday morning on account of his inability to complete all the arrangements for his expirements in time.

Mr. Upton, one of the tellers, announced that the council ticket had been elected by such majorities that it seemed scarcely necessary to announce the vote.

President Houston, after having acknowledged his re-election, read his address, "A Review of the Progress of the American Institute of Electrical Engineers," in the course of which he said:

The American Institute of Electrical Engineers is in no sense a local organization. It has in view the interests of no particular section of country, but, on the contrary, is a national body. It represents the electrical profession in all parts of our great land, and welcomes into its membership bright and progressive men in the electrical profession, wherever they may be located.

But while the Institute is in no sense a local body, so that no city can properly claim as a right the high privilege of having the annual meeting held in it, yet there is, perhaps, at this time, a special fitness that the annual meeting which witnesses the closing of the first decade of our association should be held in the City of Brotherly Love, where the Institute had its birth.

The International Electrical Exhibition, held in 1884 in Philadelphia, under the auspices of the Franklin Institute of the State of Pennsylvania, was called together at an exceedingly favorable moment. Eight years had elapsed since the Centennial Exhibition of 1876 in Philadelphia had sown broadcast the germs of public interest in electricity, and thus laid the foundation for a belief in the bright promises of the electric future. These germs, carried to all parts of the land, were beginning to bear fruit, and a body of earnest and intelligent workers had sprung up on all sides, so that our comparatively limited knowledge of electrical science was markedly increased, although in an extremely irregular and unsystematic manner.

Between 1876 and 1884, nearly a decade, the work done in the electrical field was necessarily of a pioneer and independent character. The great principles of the science already discovered and announced were but vaguely understood, and needed the practical man to carry them into actual commercial use. To a great extent each investigator trod the path of discovery alone, gropingly penetrating into the regions of the unknown, unaccompanied by his fellow-investigator, and often, indeed, unconscious of his existence. Had this early work been properly organized much of the labor expended in going over ground already trodden might have been saved; but it is by no means clear that this labor was in vain for the weal of the electric future, for truths thus repeatedly wrested from nature and established again and again by independent investigators cannot be too highly prized.

In our nineteenth century activity events move rapidly. In less than a decade from the time of the Centennial Exhibition of 1876, namely, in 1884, the time had come when the advantages of congregation as opposed to segregation were to be demonstrated, when the lonely investigator was to be brought into contact with his brother toiler and taught the advantages of organized work and free exchange of ideas.

Happily the International Electrical Exhibition in Philadelphia, of 1884, already alluded to, brought together the workers in electricity both in this country, and to a certain extent, in other parts of the world, not only during the exhibition itself, but especially during the completion of the buildings and the arrangement of the exhibits. The varied exhibits thus brought together from all sides were a revelation to these hitherto independent workers, and showed them from what had already been accomplished by electrical science what might reasonably be expected in the near future. The stimulus, so excited, culminated in the organization of the distinguished body I now have the honor of addressing.

At the same time the United States government appointed a United States electrical commission, authorizing it to conduct a national conference in Philadelphia during the progress of the International Electrical Exhibition. Fortunately for the cause of electrical science, the commission, after due deliberation, determined to appoint as members of this conference not only those investigators in the physical laboratory and lecture-room, the college and university professors, whose labors have always proved of such immense value to the world's weal, but also those equally important investigators, the inventor and actual worker in the commercial electrical field, whose knowledge of principles is based on actual experience; a class that proves the correctness of its ideas by subjecting them to the test of actual trial on a commercial scale.

There was thus convened in 1884, in the city of Philadelphia, a notable gathering of men who had long toiled in the electric field, both in the so-called pure sciences and in the applied sciences, and I feel sure that each class recognized the fact that it learned much from the other.

I think it would be difficult properly to estimate the good that has accrued to electrical science, not only in this country, but also in the world at large, from a properly organized association of specialists in a practical branch

of science like that of electricity. If we can properly trace from the circumstances attending a single electrical exhibition and series of conferences held in Philadelphia in 1884, a great awakening in the field of electricity, what must have been the influence for good exerted by a body like ours, which, I think, I am correct in saying includes all the distinguished practical electricians in this country?

A glance at the transactions of the Institute will show the extended and valuable character of the work of its members. This work embraces notable inventions, extended commercial applications and valuable researches; as, for example, researches in high frequency discharges; the development of alternating current apparatus for electric welding and for the transmission of power; improvements in continuous current apparatus; improvements in the practical applications and control of electric motors, for traction, mining, manufacturing and other purposes; improvements in telephony and in telegraphy; improvements in the application of electricity to various chemical processes; improvements in designs for electric machinery; improvements in electric lighting apparatus of various descriptions and developments in electro-therapy.

The work of the Institute as a body has also been of a broad and valuable character. Another action of which I think the Institute may be proud has been its provisional adoption of the well-known names of Gilbert, Oersted, Gauss and Weber for the most important quantities in the magnetic circuit, thus filling a well-defined void in the practical development of the dynamo, motor and magnets generally. These names have already been favorably commented on in Europe, where they have been embodied in at least one standard text book.

It would be ungenerous in me in thus reviewing the causes which have led to the development of electrical science in this country to fail to mention another potent factor. I refer to the electrical press. I recognize its power and the good it has accomplished in spreading broadcast over the country, not only to the members of the Institute, but to all interested in electrical progress, the knowledge of every great advance made in electric science. In a certain sense, however, the electrical press supplements the influence of the Institute, because the press, unlike the Institute, cannot bring electrical workers together, but can only guide and disseminate the conclusions they have reached.

We are naturally and properly proud of the progress shown by our Institute in the first decade of its existence. I ask you now in all seriousness how has this progress been assured? Clearly by the establishment of a central, organized body, as distinguished from separate, independent and possibly antagonistic bodies; by the establishment of a central body, which derives its authority from a membership extending over the entire country.

Is it credible that independent, disconnected and possibly antagonistic societies, located in as many separate cities as there are groups of members sufficient to form separate societies, can hope to accomplish as much good in so short a time as has been accomplished? Would not the disintegration of our Institute prove to the electrical engineers of this country little short of a calamity? Might not the establishment of separate organizations result in mutual jealousies and intense sectional feeling, and, consequently, in a tendency to the continuance of errors once contracted?

Partisanship and intelligent scientific work, in the nature of things, have nothing in common. The true scientific instinct is shown in the desire to know the truth for the truth's sake, and the true electrical engineering instinct is to accomplish the best work in the most economic manner possible. To insure the greatest success I feel sure you will agree with me there must of necessity be a central governing body, viz.: The council of the Institute, deriving its authority from a membership extending all over the country, and vested with the power of speaking authoritatively for the Institute between the periods of recognized official meetings.

Prof. Anthony followed with a paper "On the Subdivision and Distribution of Artificial Sources of Light." This was a discussion of the minimum theoretical luminous efficiency of units of various kinds in various arrangements, dealing only with the direct rays and not considering the modifying influences of reflection. The discussion led to a comparison of the effective illumination under these conditions between incandescent and arc lamps. The conclusion was that "unless the area to be lighted is so large as to require about 500 incandescent lamps distributed uniformly over it, the use of full (so-called 2,000 candle power lamps) arc lamps requiring the same power, will leave some parts of the area less brilliantly lighted."

Speaking of arc lamps, he said: "And here I wish to enter a protest against the assumption that I often find in discussions of this subject, that the so-called 1,200 and 2,000 candle power arc lamps are 1,200 and 2,000 candle lamps. There is no 450 watt arc lamp in use that will measure 2,000 candles in the direction of greatest intensity, and compared with other artificial sources for general illumination, that is, measured as other sources are measured, there is no 450 watt lamp that will give, when surrounded by a glass globe, 500 candles."

Continuing, he said: "Of course, in deciding between the use of arc and incandescent lamps in any special case, there are other questions to be considered besides that required to operate. Practical questions of installation may outweigh all others. The question I have considered is purely one of efficiency, and in treating that question I have assumed that every part of a space to be lighted needs the same amount of light. I have omitted from the consideration all effects of reflection from ceilings, walls, or reflectors purposely provided, as these are too various and depend too much upon the conditions in each special case to be introduced into a general discussion. My main object has been to point out to just what extent the general illumination of a space is affected, other things being equal, by the use of large in the place of small sources using in the aggregate the same power, and I trust the figures and illustrations I have given may be found useful in considering the special cases that may arise."

Quite a discussion followed, which was opened by Mr. Perry, who said he was astounded at some of the figures given by Prof. Anthony. Thousands of determinations of the candle power of so-called 2,000 candle power lamps had been made which had varied between, say, 750 to 1,500 candle power. Some had gone higher than the larger and some below the smaller figure, but taking 1,000 as the mean, which was fair for these determinations which were made without globes, Prof. Anthony's figures would seem to imply that clear globes absorbed 50 per cent. of the light, which, of couse, every one knew was impossible. Prof. Anthony had stated that no 450 watt lamp, when surrounded by a glass globe, gave 500 candles. This certainly could not be correct.

Prof. Houston said he could not believe such a statement, and asked whether the figures applied to long or short arcs. The reply being that they applied to long arcs he said he had asked the question purposely, thinking that if they applied to short arcs they were due to the shadow occasioned by the crater. He could not see how such figures could be true, and thought there must be some mistake.

Mr. Hammer asked if the figures, 500 candle power, had been computed, or were they the result of test. It was a matter of great importance that such a statement should not go out if it were not true. He also asked what Prof. Anthony would allow for minimum, and what for average candle power?

Prof. Anthony replied that the 500 candle power meant the mean spherical illumination.

Prof. Houston reiterated his opinion that Prof. Anthony's figures were wrong, and stated that he did not think it fair to measure the illuminating power of an arc lamp alone in a horizontal direction.

Mr. Steinmetz thought the figures given probably not far from correct. He had worked an incandescent lamp up to an efficiency of about ½ watt per candle. This was the temperature at which it broke, and about the temperature of the volatilization of carbon, and consequently about the temperature of maximum possible illumination of carbon. The results he obtained tallied fairly well with Prof. Anthony's figures.

Dr. Pike stated that he had made a very large number of determinations of the illumninating power of so-called 1,200 candle power lamps, and his results tended to corroborate Prof. Anthony.

Mr. Pope suggested that the practical efficiency depended upon the purpose of the lamp.

Mr. Upton, in speaking of the effect of reflection upon illuminating efficiency, said that it had a very marked effect and varied with the character of the walls. Different rooms would vary three fold in the illuminating efficiency of the same lamps.

There being no further discussion, Mr. Hammer arose and stated that he wished to bring before the Institute for their consideration the standard rules adopted by the National Electric Light convention for electrical construction and operation. These rules were the outgrowth of a number of years' work by the committee of the National association, and he believed were now nearly perfect. Every one recognized the desirability of having uniformity in such rules, and he believed that they were a proper subject for action by the Institute. The National Electric Light association desired to have the Institute take official action on them, believing that if they met the approval of this body, uniformity of practice would be assured. To this end he moved that the president appoint a committee of five to consider the rules.

President Houston appointed as such committee Messrs. Hammer, Perry, Steinmetz, Kennelly and Weston.

The session then adjourned to visit the power station of the Philadelphia Traction company. Upon reaching the station the members were taken in charge by C. A. Bragg, manager of the Philadelphia office of the Westinghouse company and E. E. Keller of the Pittsburgh office, who explained every detail of this magnificent plant. There are at present five multipolar generators of 500 horse power each in operation and there are foundations completed for four 1,500 horse power generators and engines in addition. The Philadelphia Traction company has 300 miles of track covered by cable, horse and electricity. This is all being transformed into electric lines. At present the company operates 178 motor cars in regular service, and during busy hours it puts on 25 to 30 more.

THE RECEPTION AT THE MANUFACTURERS' CLUB.

In the evening the members of the Institute were tendered a reception by the engineers and manufacturers of Philadelphia under the auspices of the Engineers' club and the Electrical Section of the Franklin Institute. On this occasion the elegant quarters of this most conservative and exclusive club, the Manufacturers' club, were thrown up. The Philadelphians turned out strong to make the event a pleasant one and the ladies added their charm to the occasion by a generous presence. On the third floor rear, is the ball room which was especially decorated for the occasion with ferns and vines among which were interspersed a profusion of colored miniature incandescent lamps. The effect of this was charming and was still further enhanced by the beauty of the ladies and their costumes and the strains of the waltz to which not a few kept time. The front part of this floor was monopolized by the bachelors and other horrid men who preferred the solace of the weed to those of terpsichore. Up stairs another flight an elegant spread was provided and the patter of footsteps both ascending and descending testified to the high appreciation in which this part of the entertainment was held.

At a late hour this meeting adjourned also, but the occasion will always be cherished by those who participated in it, as one of the pleasantest of their experience.

WEDNESDAY MORNING SESSION.

The meeting was called to order promptly at 10 o'clock, and after a few announcements by the secretary, W. W. Griscom of Haverford, Pa., was introduced, who read a very well prepared paper on "Some Storage Battery Phenomena." Mr. Griscom has been a very intelligent and earnest student of the storage battery, and was listened to as an authority. The disrepute into which the storage battery has popularly come on this side of the Atlantic was tersely and amply explained in the following sentences: "A storage battery continually worked to its commercial rating is a commercial failure. A storage battery worked sufficiently within its capacity is invariably a commercial success."

A number of curious phenomena noticed by the speaker in his study of the question were spoken of and explanations suggested.

After the close of the paper, Dr. Duncan added some interesting remarks on his own work in the same direction, and the remainder of the morning session was devoted to the reading of Mr. Wurtz's paper on "Discriminating Lightning Arresters and Recent Progress in Means for Protection Against Lightning."

This lecture was fully illustrated with experiments, and elicited a very full discussion, in which Messrs. Kennelly, Steinmetz and Jenks took a prominent part.

AFTERNOON SESSION.

Prof. Crocker's paper was the first on the programme. Its title was "Unipolar Dynamos for Electric Light and Power." This paper excited some rather pointed criticisms.

Prof. Dugald C. Jackson's paper on "Alternating Currents and Fuse Wires," in the absence of the author was read by Prof. P. Jackson. Dr. Waldo suggested that much of the value of the paper was lost because the analysis of the metals were not given.

The next paper was by Prof. R. B. Owens, of Lincoln, Neb., on "Test of Closed Coil Arc Dynamos," in which he gave some details of tests made on the Wood arc machine.

"The Relative Advantages of Toothed and Smooth Core Armatures," was the title of a paper by Alton D. Adams which was read by Prof. Anthony. The discussion which followed occupied the rest of the afternoon.

THE ANNUAL DINNER.

This dinner, served at the Hotel Metropole, was one of the most noteworthy social-scientific events from an electrical standpoint, that has occurred in this country. President Houston presided and called upon the following named gentlemen to respond to the sentiments selected:

The Electrical Press.....George M. Phelps
Commerical Electrical Engineering....H. Ward Leonard
Mathematics and Electricity .....A. E. Kennelly
The Philadelphia Committee.....Elmer G. Willyoung
Electrical Engineering Education.....Dr. M. I. Pupin
Electricity and Time.....James Hamblet
Power Transmission.....C. F. Scott
Electricity in the West.....Prof. R. B. Owens
The Electrical Expert.....Prof. Wm. A. Anthony

The responses to these toasts were remarkable for the apparent endeavor to avoid anything approaching levity. Mr. Kennelly's response to the toast "Mathematics and Electricity" which was expected to be more or less techni-

cal proved to be the happiest effort of the evening, and was received with great applause.

THURSDAY MORNING.

Rather more promptly than would have been expected from the late hour of adjournment of the previous night, the meeting was called to order by Prof. Houston and after a number of announcements had been made, Mr. Willyoung read his paper on "Standardizing Electrical Measuring Instruments." He was followed by Dr. Bidell, who read a most important paper describing a new optical phase indicator. His paper was an account of a new device for solving in a very simple way what has heretofore been considered a difficult problem.

Prof. Albert C. Crehore's paper, which came next in order is likely to be epoch-making. In this he described a method of his invention by which it was possible to record any kind of variable current at its instantaneous values, using for this purpose the rotation of a beam of light instead of that of a ponderable body.

Thursday afternoon and evening were given up to a "planked shad dinner" at Gloucester, N. J., which was certainly the crowning feature of the social side of the convention.

After visiting Cramp's ship yards the members re-embarked on the small excursion boat and proceeded down the river.

Of course the first thing on the programme upon reaching Gloucester was to take up a more or less graceful grooping before the camera. And after this the party was invited to take a ride on the Gloucester electric railway. This pleasant trip over no time was lost in testing the virtues of Delaware shad, and if one could judge by the rapidity of its disappearance, the flavor was fully appreciated. Then followed the intellectual feast. T. C. Martin, acting as toast-master, made the condition, that on account of the great levity indulged in by the speakers of the evening before, not more than one joke was to be perpetrated by any one speaker on the occasion in hand.

Dr. Emery, who led off with a very humorous and happy speech, was followed by others in the same vein, but the particular feature of the whole occasion was Steinmetz's exposition of the possibilities in the way of lightning arresters, which would revolutionize all of our present methods by utilizing the power of the tidal waves, which were to be stored in vibrators at stations along the coast and transmitted through space. Steamships, railway trains, etc., would be supplied with current by erecting resonators to collect the ethereal vibrations sent out from the coast stations.

After the toasts were finished, the party re-embarked and after sailing down the Delaware and back through the Schuylkill river, reached Chestnut street about ten o'clock in the evening.

FRIDAY'S SESSION.

The members, apparently none the worse for their trip down the river, were prompt in their attendance on this last morning of the convention, and Dr. Pupin, realizing the shortness of the time at the disposal of the Institute, instead of reading his paper in detail, gave the substance of it in a series of remark which covered his investigations on resonance analysis of periodic currents.

Dr. Duncan's paper on experiments, with two-phase motors, closed the consideration of papers. He presented a large number of diagrams, but unfortunately his paper was not in the hands of his audience, and did not receive the discussion it deserved.

Thus closed the most memorable convention in the history of the American Institute of Electrical Engineers.

Engineers Visit the LaRoche Works.

Of the many hospitalities extended the visiting delegates to the meeting of the American Institute of Electrical Engineers at Philadelphia, none was more enjoyed than the impromptu reception given by the LaRoche Electric Works at the close of the business session of the Institute on Friday, when some fifty delegates under the escort of Secretary J. Frank Stevens, of the LaRoche company, were taken out to its factory. The visitors were welcomed by President LaRoche, and after subscribing their names to the register, that they might receive a souviner of the occasion, they were invited to partake of a bounteous luncheon. At the request of the visitors, T. C. Martin expressed the thanks of the company and proposed the health of President LaRoche, and the success of the concern, which was received with hearty applause. President LaRoche responded in a few well chosen remarks, stating that the limited time given to prepare for the occasion did not allow him to do as much as desired, and expressed the desire that all would make themselves at home and thanked the delegates for the visit. Ralph W. Pope proposed that a vote of thanks be given the LaRoche Electric Works, which was done with a cheer, after which President LaRoche, assisted by his lieutenants, J. Frank Stevens, G. S. Loutey, G. T. Coleman and H. F. Robeno, conducted the visitors through the extensive factory, the arrangement of which received many compliments. The apparatus being tested, consisting of three 1,500 and one 1,300-light machines, and six 300 horse power multipolar generators, was carefully inspected and pronounced a fine showing of electrical apparatus. The large exhibit of electrical instruments manufactured by the Keystone Electric company, in charge of J. W. W. Cornman, received special attention, as they presented several new ideas in measuring instruments. Mr. LaRoche is also president of this company. The LaRoche Electric Works report that they are at present enjoying the most successful business since they have moved into their new works, having a large number of orders, and during the dull season have never run less than full time.

Metropolitan Elevated Electric Railway.

Preliminary work for the electrical construction for the new Metropolitan elevated railroad on the West Side, Chicago, is now under way. It is in charge of W. E. Baker, late general manager of the Intramural road at the World's Fair, who has been retained by the Metropolitan company in an advisory capacity as an expert in elevated electric railway work. It will be some time before the details of power house and line work will be decided upon.

Cummings Electric Carriage.

Of late years great interest has been manifested in the electrical propulsion of individual vehicles. Among the first to recognize the importance of this field was G. K. Cummings of Chicago who has recently finished and put in operation an electric carriage embodying the latest designs for successful and commercial operation. The primary objective points seem to be strength, positive action of the driving apparatus and simplicity.

CUMMINGS ELECTRIC CARRIAGE.

An examination of the accompanying illustration will show that the gearing is positive and direct in action, while the use of the link belt allows a certain flexibility which, it is claimed, is necessary. The speed is under perfect control by means of the foot pedal actuating a switch under the forward part of the carriage. The direction of the carriage is controlled by the hand wheel and the various parts are accessible and simple.

The motor is a two horse power series wound 24 volt machine. The end of the armature shaft carries a rawhide pinion engaging with an iron gear on a countershaft directly connected with the rear axle through a link belt. The rear wheels are both driven, but when the vehicle turns a corner or deviates from a straight course, by an ingenious device through a system of hardened steel roller clutches, either driven wheel may move independently of the shaft or the other wheel, so that the one on the outside of the curve will automatically adjust its speed to the distance it has to traverse. This difference of speed of the two driven wheels is considerable, as on the sharpest turn the periphery of the inner wheel covers only half the distance traveled by the outer one. The front axle is made of aluminum bronze, is rigid and carries two short supplemental movable axles to which are attached the front wheels. The movable axles are connected to each other by a pivoted iron bar so that their action is reciprocal. The inner end of the right hand one is toothed, engaging with a pinion on the end of the shaft carrying the hand wheel. The framework of the running gear is of angle iron supporting four springs placed longitudinally with the body of the carriage, which has a seating capacity of four people.

The current needed is derived from 200 ampere hour storage battery cells placed under the seats of the carriage. The brake is a leather-lined steel band clutch.

Recent tests of this carriage show that over level city roads at a normal speed of ten to twelve miles an hour a maximum average of from 1¼ to 2 electrical horse power is all that is required, the difference in power consumed depending on the state of the roads and the style of paving traversed. The questions of running through the mud, over street car tracks, raised obstruction such as manhole covers and the like, starting up from ruts and gutter have each been taken up carefully in turn and through practical experience and actual operation, it has been demonstrated that the vehicle successfully and easily overrides such obstacles. A series of tests is now being made in which careful readings are taken while the carriage is subjected to all manner of conditions likely to be met with on the streets of a large city.

Taking as a basis a daily run of 50 miles at 10 miles an hour, and granting that one horse would be sufficient to haul the load and travel this distance every day, the cost of board alone would be in excess of the cost of current taking the average consumption of power at two electrical horse power, which at the published rate of charge for current of the Chicago Edison company would be only $10 per month. This would be cut down to $5 or $6 per month if an average daily trip of 20 to 25 miles be made, and this latter it is claimed would be a maximum average for a great majority of city vehicles.

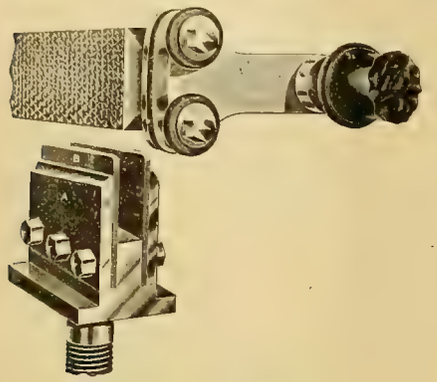
A company is being formed to put a line of these carriages on the market, including six seated phaetons for use in the park systems in large cities, and smaller vehicles of the three wheel variety to seat two persons.

The city council of the City of Mexico has granted a concession to J. Carter of Chicago for the establishment of a telegraph messenger service in the city. Mr. Carter, after spending some time in Mexico, has returned to Chicago to perfect arrangements with his associates for the carrying out of the enterprise. It is intended to open the central office in the business portion of the city, where the business will be started with twenty boys in uniform.

The London *Electrician* is authority for the statement that an English officer, named Harrington, has discovered in India a working telephone between the two temples at Pauj, about a mile apart. The system is said to have been in operation at Pauj for over 2,000 years. "In this connection," says that journal, "we may observe that Egyptologists have found unmistakable evidence of wire communications between some of the temples of the earlier Egyptian dynasties; but whether these served a telegraphic, telephonic or other purpose is not certain."

Improved Switch.

The W. S. Hill Electric company of Boston is manufacturing an improved switch, illustrated in the accompanying cut. The first feature in the invention is the manner in which the two or more blades are secured to the yoke so as to obtain rigidity and keep all of the blades in proper alignment while the switch is being operated. The outer ends of the blades and yoke have been broadened and two screws or bolts inserted, thus securing the parts so rigidly that the blades must at all times move in unison, and all the blades leave the contacts at the same instant. Another feature consists in backing up the regular flexible contacts *B* by "reinforcing plates," *A*. Where nothing but copper strips were used these, of necessity being

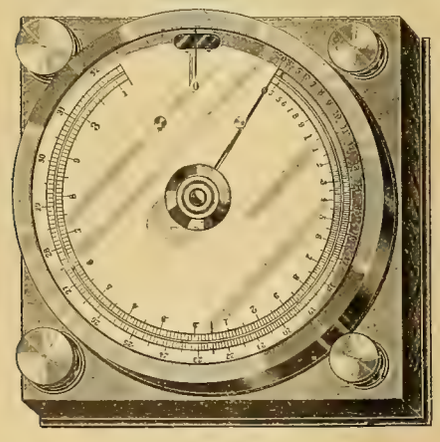


IMPROVED SWITCH.

flexible, were liable to spring apart by constant usage, thus impairing the contact and causing the parts to heat. By the method shown, the flexibility is maintained, the flexible contacts are always held in proper position, and the electrical connection between blade and contact is always kept perfect. The carrying capacity of the flexible copper plates *B* is increased by the reinforcing plate *A* to the maximum of any other part of the circuit, preventing loss of current in the switch and heating and destruction of its contacts.

Alternating Currrent Ammeter.

In the accompanying cut is shown a new alternating current ammeter, the invention of Dr. A. H. Hoyt, and manufactured by the Whitney Electrical Instrument company, Penacook, N. H. The invention is designed principally for lamp and meter measurements on alternating circuits. These instruments are made up both as ammeters and voltmeters, and the double scale ammeters of this type are particularly valuable, as the same instrument will make single lamp tests or full meter measurements. These instruments are direct reading, portable and specially adapted for lighting stations using alter-



ALTERNATING CURRENT AMMETER.

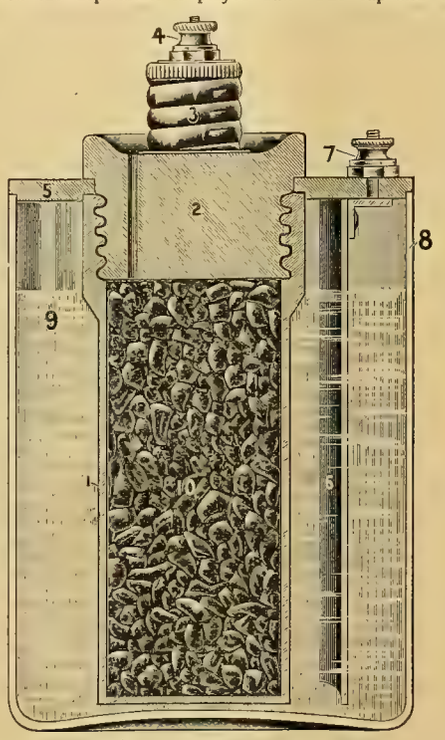
nating currents and for lamp manufacturers. The armature works against a double spring torsion, similar to a dynamometer, and no leveling screws are necessary. The normal position of both armature needle and index pointer is at zero. When the current passes through, the armature needle is deflected. The index pointer is then moved round until the needle is brought back to zero, when the correct reading will be indicated on the scale.

With the low reading instruments a reading may be taken to $\frac{1}{1000}$ of an ampere, and these readings are correct to one-half of one per cent. The instruments are made in various ranges to meet the demands of the trade, are handsomely mounted and can be used as a laboratory standard as well as for outside testing.

Hayden Carbon Porous Cup Cell.

The Hayden carbon porous cup cell, shown in the accompanying illustration is made by the Hayden-Booker Manufacturing company of St. Louis. In the cut the parts are indicated, 1 being the carbon porous cup itself. This cup is made by a special process which renders it very porous. The walls are but one-quarter inch thick, and the cell attains its full strength immediately it is set up. The cup is screw-threaded at its upper end to receive a carbon screw cap, 2. This cap is close-grained carbon, and being a separate piece can be and is treated so that it cannot absorb moisture. Other parts of the cell indicated are: Metal screw cap, 3; binding post, 4; jar cover, 5; zinc, 6; zinc binding post, 7; jar, 8; solution, 9; depolarizer, 10.

The jar cover is clamped between the carbon screw cover and the carbon cup is provided with an opening for the zinc, which is clamped to the cover, though a loose zinc can be used, but if so, then the zinc or carbon must have rubber bands to prevent contact between the two. In the usual carbon porous cup or clay cup cell where a depolarizer is used, the whole element is worthless when the depolarizer is played out. The cup and its



HAYDEN CARBON POROUS CUP CELL.

cover being indestructible and not injured by service or time, the only renewal necessary is the filling.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 21.—Discussion of the question of granting the Cataract General Electric company a franchise to establish a system of electric propulsion on the Erie canal has been revived by the veto which Governor Flower has filed, returning the Gerst repeal bill to the Legislature. In 1893 the Legislature passad an act providing for experiments on the canals with electricity as a motive power. The second section of the act reads as follows:

The superintendent of public works may from time to time authorize any person or corporation to construct, maintain and operate electric conductors for light, heat or power, upon or along any canals of the state or any portion thereof, upon such terms and conditions not inconsistent with the public use of such canals, as he may impose; and in like manner he may contract for or permit the use of such light, heat, or power upon such canal, provided that he shall thereby create no charge against the state, except as against appropriations lawfully applicable to such purpose.

The legislature that passed this act understood that it was merely to give the necessary authority for experiments with electricity, which the governor had recommended. Late in the year it was discovered that the superintendent of public works put a very broad interpretation upon the law, assuming that he had the power to grant a fifty-year franchise for the supply of power on the canals and for the use of the canals in transmitting power for other purposes, and that he was actually negotiating to this end with a company made up of rich men and influential politicians. As a monopoly of this kind ought not to be granted and was never intended, a bill repealing the law o 1893 was introduced early in the session, but before this bill could be passed Superintendent Hannan granted a franchise to the Cataract General Electric company. A committee of the Legislature investigated the action of the superintendent of public works in granting the franchise and reached the conclusion that while that act was not unlawful it was unwise and improper; and the passage of the repeal bill was the only way in which the Legislature could express its disapproval of that action. It was known that this repeal could not affect the action of the superintendent of public works in making the contract with the Cataract company. The governor bases his veto on the ground that the repeal would give the Cataract company a "complete monopoly," yet it is hard to see where under existing circumstances there is any room for a competing company. The entire proceeding is discreditable if indeed it is not positively dishonest.

Samuel L. Tredwell, a stockholder of the Consolidated Electric Light company, has begun a suit before Justice Barrett in the Supreme Court against Hugh R. Garden and Henry C. Davis. The former is vice-president and the latter is a director of the company. Tredwell alleges that they have mismanaged the affairs of the company, have been wasteful and have illegally transferred $250,000 of the stock of the company.

The first report charging the fire in the Brooklyn Tabernacle to electric wires has been denied, the sexton announcing that there were no wires near the place that the fire started. This is both interesting and encouraging, showing as it does that people are beginning to get over the idea that a fire in a building in which there are wires must necessarily be charged to electricity.

The trolley car tie-up on the lines of the Atlantic avenue railroad system in Brooklyn came to a peaceful end tonight. The victory was about equally divided between the men and the company. The company at a conference with its men made several concessions. The president said he would give the motormen until July 1st to pay for the new regulation gray uniforms. He promised further that they should lose no pay for the time they were absent during the lockout. This the men accepted and the lockout ended. W. F. O.

Milwaukee, Wis.

MILWAUKEE, WIS., May 19.—A movement to establish a municipal electric lighting plant in Milwaukee has been set on foot. No sooner had the new common council got down to business than Alderman Rauschenberger, the president of the body, introduced a resolution for the appointment of a committee of five to look into the question of electric lighting on a municipal basis. The resolution was adopted and the committee was appointed. It consists of Aldermen Muenzberg, Rademaker, Devos, Renning and Ramsey. At the first meeting of the committee the city clerk was directed to write to other cities which had municipal electric lighting plants and get figures as to the cost of establishment and maintenance. The mayor, the aldermen, the members of the common council and all the city officials appear to be in favor of the plan. Mayor Koch believes that the city is paying too much for electric lights and that if it had a plant of its own it would save a great deal of the money now paid to private corporations. The city comptroller ventures the opinion that if the city should establish a plant of its own it would in a few years save the price of it. The proposition is to issue bonds in order to raise money for the establishment of the electric light plant. There is a limit to the bonded indebtedness of the city, but the comptroller states that if necessary the sum of $600,000 could be raised on bonds for the building of the proposed municipal plant.

There has been more or less talk to the effect that the Milwaukee Street Railway company was in danger of going into the hands of a receiver, but it is now known that the company is absolutely safe. All the holders of the company's bonds have agreed to waive their interest for a a period of eighteen months. The agreement was made some time ago, and it included the interest which became due last December. Thus the company will have to pay no interest on its bonds until June 1, 1895. The company has issued bonds to the amount of $11,250,000, and they bear interest at the rate of 5 per cent. per annum. The yearly interest on these bonds is $562,500, and the interest for eighteen months, being the amount that the bondholders have surrendered, is $843,750. It is somewhat, doubtful, however, whether the holders of the last issue of bonds, amounting to $1,125,000, have surrendered their coupons; in fact it is stated in some quarters that the whole of the last issue has not been placed. Recently the company claimed that the daily receipts were $300 less than the operating expenses and the fixed charges. The

interest on the bonds was of course included in this estimate. Since the estimate was made the travel on the lines has increased as a result of the warm weather, and the surrendering of the coupons without payment of interest reduces the fixed charges to little or nothing. The company will probably make a profit right along, under the circumstances, and by next June, when interest becomes due, it will be in pretty fair condition. The North American company, by the way, is the principal holder of the Milwaukee Street Railway company's bonds. Some of the bonds, however, are held in Milwaukee.

The Milwaukee Street Railway company is anxious to extend its Martin street line to the lake front. It has a line running along that street west from Jackson street to the river and across to the Third street and other lines. The distance from Jackson street to the park on the lake front is four blocks, and the company would very much like to get a franchise to extend its lines that distance. Such a line would give many West Side people easier access to to the lake front than they now enjoy. However, it would run along a very exclusive residence thoroughfare, and it if doubtful if the common council could be prevailed upon to grant the franchise.

General Manager Wyman announces that the Milwaukee Street Railway company will extend the Farwell avenue electric line to Whitefish Bay if the interested property-owners will pay a bonus of $18,000. The extension to the upper lake shore park will bring the electric cars quite a distance nearer Whitefish Bay, and it is said that the bonus of $18,000, which the company asks, will build and equip the line to the bay.

Alderman Thuering is starting a crusade in the interest of lower street car fares. He proposes to compel the company by ordinance to charge a fare of only 3 cents during the morning and evening hours, when workingmen are going to and returning from work. The company will, of course, fight the proposition. Even at 4 cents, which is what the fare amounts to now if tickets are bought, Mr. Payne claims that the company loses money.

The Wisconsin Telephone company has decided to build two metallic double circuits between Milwaukee and Waukesha, Oconomowoc, Watertown and Madison; an additional circuit between Waukesha and Oconomowoc, to connect Pewaukee, Hartland and Nashotah, and a new line from Lakeside to Hartland.

The Gibbs Electric company has increased its capital stock from $10,000 to $30,000. The original members of the company were L. T. Gibbs and M. H. Johnson. The new stockholders are George Gibbs, mechanical engineer of the St. Paul railway; J. N. Barr, superintendent of motive power of the same road; J. A. Whaling, purchasing agent of the Wisconsin Central road; A. L. Cary, D. R. Brigham and D. L. Barnes. L. T. Gibbs continues in the management of the company.

The Milwaukee Brotherhood of Electrical Workers has petitioned the Common Council to provide for the appointment of a board of three examiners, whose duty it shall be to examine all persons engaged in the business of electric wiring. One of the examiners is to be appointed by the mayor of the city, another by the president of the Brotherhood of Electrical Workers and the other by the Board of Underwriters. It is proposed that only such persons as pass the examination of the board shall be permitted to engage in the business of electric wiring and that they be duly licensed. The charge is made that most of the electric wiring in the city is done by small boys and that their careless or inferior work greatly endangers life and property. The Davidson Theater fire, which the union declares to have been caused by faulty wiring, is held up as an example of the dangers of the present system. The idea of the union is to have no unskillful man employed in the work except as a helper to some experienced electrician. The union has also adopted a resolution strongly commending the plan to have a city electric wire inspector appointed.

C.

PERSONAL.

James I. Ayer was in Chicago last week.

L. B. Stillwell of the Westinghouse Electric & Manufacturing company was in Chicago last week.

Capt. Willard L. Candee, and Geo. T. Manson of the Okonite company, New York, were in Chicago last week.

ELECTRIC LIGHTING.

The reorganization of the Oshkosh Electric Light & Power company is now practically assured. The proposition for reorganization has been assented to by all the creditors. The company will bid for city lighting, now that its affairs are practically settled.

The directors of the Kenton, O., Gas & Electric Light company have elected the following officers: President, Thomas Espy; vice-president, Henry Price; secretary, W. S. Robinson; treasurer and general manager, M. C. McVitty. A four per cent. cash dividend and a ten per cent. stock dividend were declared.

The Cincinnati Gas company's annual election resulted in the unanimous election of A. Hickinlooper, Robert Allison, J. H. Bates, W. A. Goodman, L. C. Weir, A. Howard Hinkle and Charles Fleischmann. This was followed by meetings of stockholders of the Cincinnati, Brush, First Edison and Hauss Electric Light companies, resulting in the election of the former members of these several boards, with the exception of S. M. Felton, who was elected to fill the vacancy occasioned by the death of E. V. Brookfield. The vote at the meetings of all the electric light companies was unanimous, with the exception of the vote cast at the First Cincinnati Edison, at which the following named gentlemen were elected directors by a vote of 291 to 84: A. Hickenlooper, C. F. Hesser, Robert Allison, N. G. Kenan, E. N. Roth, L. C. Weir and H. H. Darling.

ELECTRIC RAILWAYS.

Owing to the peculiar conditions under which the street railway system of Rochester, N. Y., was laid out, all the lines pass a central point in the heart of the business district, known as the "Four Corners." The Rochester Railway company has just completed a new track at this point weighing 50,000 pounds, and costing $10,000. The entire track work at the four corners rests upon heavy ties which are firmly imbedded in a foundation of broken stone, sand and cement. The rails leading from the corners east and west on Main street weigh 93 pounds per yard,

TELEPHONE.

The Gilliland Telephone company has been formed at Chicago, with a capital stock of $1,000,000. Instruments will be sold outright, it is said. The company's factory will be located at Adrian, Mich.

Provision is made in the Japanese budget for 1894–95 for the laying of the Saga-Seki, the Okinawa and the Oki submarine cables. The amount to be expended on these works this year is about $77,850.

The fourteenth annual meeting of the Bell Telephone company of Canada was held in Montreal on February 22d. The gross revenues for the past year were $961,174 and the expenses $236,383. The paid-up capital is $2,421,600.

The Bell Telephone company has decided to discontinue the extension of the underground cable system in Toronto, Ont. The system is said to have been found more expensive than at first anticipated, and the introduction of the trolley cars is also said to have had much to do with its discontinuance, as the current from the street railway tracks was found to seriously affect the clearness of the sound in the cables. The underground wires in the central portions of the city upon Yonge, Richmond, King and Adelaide streets will, however, continue to be utilized as at present, and the aerial cables from the outlying lines will be carried by them to the central office.

At a recent meeting of the electro-technical society at Vienna a paper entitled "A Revolution in Telephony" was discussed. The paper described a system of telephony whereby one wire can be made to serve several subscribers to an exchange. The principle of the method is stated to be as follows: At a certain point to which a single wire has been carried is arranged clockwork mechanism which causes a shaft to revolve. The speed of this shaft is governed by the number of subscribers' instruments to be served. For instance, in the case of four instruments the shaft would make a complete revolution in one minute. On the circumference of the shaft are arranged contact pieces upon which feathers slide in such a manner that individual subscribers are brought successively into communication with the exchange for a short period; when the shaft is at rest the connection lasts. Each subscriber is enabled to arrest the rotation of the shaft at any moment when he is in communication with the exchange. Similarly, the exchange can stop the revolving of the shaft. The bringing to rest of the shaft is effected by means of current passing through an electro-magnet which actuates an armature, causing a catch to be inserted in the cogs of a spur-wheel. Arrangements are provided for indicating both to the exchange and to subscribers which contact is sliding under the feather.

POWER TRANSMISSION.

Work on the long-distance power transmission plant, from Folsom to Sacramento, Cal., is to be pushed, and it is expected that it will be in operation in about seven months.

Siemens & Halske of Berlin have acquired the concession for utilizing the water power of the Aare at Wynau, Switzerland. It is said that 3,000 horse power will be available.

Surveys will soon be begun for the Clear Lake, Cal., power transmission plant. Mr. Formhals, the originator of the enterprise, states that a small power plant of about 300 horse power will first be put in, by which power will be transmitted to Rumsey, a distance of 25 miles. This power will then be used for operating drills, etc., in preparing the roadbed of the proposed electric road. The large power plant will not be installed until after the railroad is completed, as the road is necessary in order to transport the machinery to the lake.

The Clear Lake Electric company, which was formed to establish an electric power distribution system in California is capitalized at $5,000,000. Clear Lake will form the source of the energy. This body of water is about 25 miles long and in places some 10 miles wide. It lies 75 miles north of San Francisco. Cache Creek, which forms an outlet to Clear Lake, will be tapped, and the water will be conveyed by three six-foot mains to a point 10 miles away, where a fall of 500 feet can be obtained. The generating plant will be established this fall.

Something new in Mexico is a jute-mill costing $500,000, which is being erected at Orizaba by an English company, with the most improved machinery and electric power. The electricity is conveyed a mile and a half to the mill from a waterfall in a stream called the Barrio Nuevo, 115 feet high, giving, it is reported 11,000 horse power. Four dynamos are employed, and in the factory each machine will have an independent motor. This is the first factory of the kind that has ever been established in Mexico. Hitherto all Mexican fiber has been exported in a raw state.

LEGAL DECISIONS.

It was held by the Supreme Court of Massachusetts in the case of Uggla against the Western Street Railway company, where a person was struck by a broken iron attached to a wire guy, the iron being part of an ear used to clasp a trolley wire and apply to it a strain from the guy, in order to keep the trolley wire in place, that the person suing must prove negligence; but when he proves the facts stated, and nothing else appears in the case, the jury may well find, and should find, negligence on the part of the corporation. Especially is this held to be correct where the jury is further instructed to consider the company's negligence in the light of all the evidence in the case. No one but it is responsible for the safety of its apparatus, and from the circumstances narrated it would not be reasonable to infer that the accident was due to the careless or willful act of any third person, or to any cause, except the failure of the apparatus to support the strain to which it was subjected in the use for which it was designed, and which was made of it by the company. It is further held to be the law that, in determining the question of what would be reasonable care, in such a case there should be taken into consideration, as one of the most important things, the apparent danger—what would be likely to happen if there was a failure to use proper care. If the danger is a danger of causing the loss of life, causing death or serious bodily injury to persons traveling upon the street, it might properly be said that reasonable care would be a high degree of care, because it would be the degree of care commensurate with the apparent danger.

The case of Murphy against Jack, recently decided by the Supreme Court of New York, was an appeal from an order granting a motion to vacate an attachment because the affidavit for it was made on information obtained in New York city by telephone from Boston. The only requirement of the New York code on this point is that the necessary facts be shown, by affidavit, to the judge granting the attachment. An affidavit made by an agent or attorney of the attaching creditor averring that the facts required to be shown exist, stating the source of his information and the grounds of his belief, is sufficient. It has been held that an attachment may be based upon facts reported to the person making the affidavit by means of a cablegram. But in this case it was contended and held by the trial judge that information acquired by telephone is not sufficiently reliable to authorize or support judicial action. The General Term reverses that decision, because it holds that there was no greater chance for error in communicating the information received in the manner in which it was communicated between persons interested in arriving at the exact facts than there would have been in a communication transmitted either by telegraph or telephone, and written out and delivered in the ordinary way. The court further says that it does not think that it would do to hold that judicial action cannot be based on information transmitted by telephone unless the person receiving it swears that he knew and recognized the voice of the person with whom he communicated. Such identification is impossible in telegraphic communication, and the precaution of repeating dispatches would afford no greater security against deception than the opportunity of personal inquiry and cross-examination over the telephone.

The case of the city of Albany against the Watervliet Turnpike & Railroad company, recently decided by the General Term of the Supreme Court of New York, was an action instituted to recover damages alleged to have been sustained by the negligence of the railroad company in the construction and operation of its trolley wire for the propulsion of its railroad cars, by reason of which a team of horses belonging to the city was killed. During a violent storm the wind broke a number of telephone or telegraph wires which were elevated above the trolley wire, and the wires fell upon it, so that a powerful current of electricity was transmitted to the detached wires, in which the horses in question were entangled and killed by the current from the trolley wire. The court, under these circumstances, holds that if the jury had found that the current which caused the injury proceeded or was diverted from the trolley wire, or its cross or span wires, a recovery could not be predicated upon that fact alone, unless there was some evidence that the railroad company was guilty of negligence in the construction or maintenance of its line. If the proof established beyond any doubt that the telephone or telegraph wire had fallen upon the trolley wire, and thence on the horses, and thus communicated a deadly current to the horses, so long as the trolley wire, which cannot be insu

lated, was in its proper place, performing its necessary and proper functions in the propulsion of cars, the court says that, within the adjudged cases of the state, it could not be said to be even the proximate cause of the injury. The proximate cause of the injury in this instance was the falling of the telephone or telegraph wires upon the live trolley wires. And the doctrine is so old as to be elementary that the injury for which damages are claimed in actions for wrongs must be the natural consequence of the wrong complained of. Upon these grounds a judgment dismissing the complaint in this case is affirmed.

Accompanying the decision in the case of Haynes against the Raleigh Gas company, recently determined by the Supreme Court of North Carolina, an opinion was filed of which the following is a brief synopsis: It is due to the citizen that electric companies that are permitted to use, for their own purposes, the streets of a city or town, shall be required to exercise the utmost degree of care in the construction, inspection and repair of wires and poles, to the end that travelers along the highway may not be injured by these appliances. The danger is great, and care and watchfulness must be commensurate to it. Passengers on railroad trains have a right to expect and require the exercise by the carrier of the utmost care, so far as human skill and foresight can go, for the reason that a neglect of duty in such case is likely to result in great bodily harm, and sometimes death, to those who are compelled to use that means of conveyance. "As the result of the least negligence may be of so fatal a nature, the duty of vigilance on the part of the carrier requires the exercise of that amount of care and skill in order to prevent accidents." All the reasons that support the rigid enforcement of this rigid rule against the carrier of passengers by steam apply with double force to those who are allowed to place above the streets of a city wires charged with a deadly current of electricity, or liable to become so charged. The requirement does not carry with it too heavy a burden. Human skill can easily place wires and poles so that they will not break and fall unless subjected to some strain that could not be anticipated, and it can as readily prevent the possibility, under ordinary circumstances, of the contact of wires that should not be allowed to touch one another.

MISCELLANEOUS.

Cornelius Vanderbilt, it is announced, has purchased an electric launch for use at Newport this season. It will be equipped with storage batteries after the manner of those equipped in the lagoons at the World's Fair last summer.

There have been several investigations of the practical workings of the Hermite process and a report recently published in England by Dr. Kelly and Dr. Piton has created renewed interest. In several English towns the authorities have been urged to make investigations and a series of experiments is proposed by the London papers.

The Rose Polytechnic Institute, Terre Haute, Ind., is thoroughly equipped, and is devoted entirely to the education of civil, mechanical and electrical engineers and chemists. Though one of the youngest institutions in this line in the country, perhaps none of them has met with greater success in filling the present demand for professional training in electricity, regarded as one of the branches of mechanical engineering. It has been able to do this by reason of a fortunate combination of circumstances, which developed its plan of instruction and the purchase of its equipment just at the time that this public demand for electrical education became imperative. While this plan insists upon and fully develops the theoretical side of the instruction, and includes the modern languages as well, it lays especial emphasis on the practical side of technical education, as it is able to do throughout the whole course of four years by reason of ample shops, drafting rooms and laboratories, and an exceptionally complete outfit of instruments of precision. The teaching force is so organized as to render shop practice most effective. It consists, in addition to the ordinary faculty of instruction, of a body of skilled workmen, or shop instructors, whose entire time is devoted to regular shop routine with the students. This makes it possible for students not only to complete the designs for machinery in the drafting rooms, but to build it in the shops, and also to test it in the laboratories. Such an education is modern and valuable. Not only are young men generally interested in such studies, but at graduation they are prepared to enter upon a useful professional career in connection with increasingly important business interests.

TRADE NEWS.

The Central Electric company, Chicago, has about completed negotiations to handle a superior telephone, which it expects to place on the market about June 1st.

W. E. Parker will represent the F. P. Little Electric Construction & Supply company in the West, his headquarters being at 186 and 188 Fifth avenue, Chicago. Mr. Parker will be prepared to engage in all kinds of electrical work and supply the specialties handled by the Little company.

C. E. Lee has removed his headquarters from the Lees building, Chicago, to 615 Medinah building, Jackson street corner of Fifth avenue, where he has arranged to carry a full line of batteries and electrical specialties. Mr. Lee has the agency for the Samson battery, Hayden-Booker battery, Leavitt motors and Abatis Electric company's house goods.

The Mason Electric company of Chicago of which W. R. Mason is the leading spirit, calls attention to the Medbery insulation for electric railway supplies in a recent circular. It is said that this is the only electric railway insulation sold under an absolute guaranty. The material is said to be strong and tough, acid and weather-proof, not affected by changes of temperature and possessing high insulating qualities.

The new catalogue issued by the Central Electric company, Chicago, seems to be in great demand, and requests from all parts of the United States and Canada are being received daily. The Central company is well satisfied with the amount of business it has done so far during the month of May. It reports a large and growing demand for interior conduits, and states that the metal sheathed bushings are growing in popularity.

Montgomery H. Johnson has opened an office in the Martin Building, Utica, N. Y., as a consulting electrician. Mr. Johnson announces that he will make determinations, designs and drawings for electrical machinery and apparatus; plans, specifications and estimates of electrical work; scientific tests on operating electric plants and report on proposed extensions; investigate and report on new electrical enterprises and securities and design, dynamos, motors, transformers or any electrical apparatus, to fill special requirements, and superintend their construction if necessary.

The Gisholt Machine company of Madison, Wis., has issued a pamphlet upon "Modern Turret Lathe Practice," containing numerous illustrations and considerable valuable information for those engaged in this line. It is proposed to issue this pamphlet monthly, the publishers explaining this decision by saying that the range of application of the turret lathe is so large, and many of the most successful operations are so different from accepted practic, that they are convinced that it will be cordially received by superintendents, foremen and proprietors of manufacturing machine shops. The illustrations will be taken from current practice, and will represent the latest productions. In the first publication the following machines are described and illustrated: Forty-two-inch gap lathe, turning plate couplings; two-inch spindle turning machine, turning elevating screws; 28-inch standard turret lathe, turning Corliss engine bonnets; 2½-inch screw machine, turning shoulder studs.

BUSINESS.

The Sioux City Brass Works report a good business rewinding armatures and repairing commutators. They have a well equipped machine shop and are casting a fine grade of tempered copper in their foundry.

It is announced that the Card Electric company will soon begin to erect its new plant on Longview avenue, Mansfield, O. The first building will be 150 by 50 feet. Three acres will be purchased by the company to provide for future buildings. At present the plant is in quarters at the Mansfield Machine Works.

The Pharos incandescent lamp which is being exploited by the Central Electric company, Chicago, is winning public favor and confidence, and the Central company is more than pleased with the number of lamps which it has sold during the past week. Orders for Banner weather-proof wire have increased considerably, among them being quite a few unusually large ones.

The Holtzer-Cabot Electric company of Boston signalizes the opening of the summer season by issuing a circular calling attention to the prominent features of its fan motor specialties. The company has placed on the market an alternating fan motor for which it makes strong claims. A complete motor and dynamo catalogue has been prepared by this company for circulation among the trade.

The Weston Engine company of Painted Post, N. Y., has issued a new catalogue, which, aside from its artistic excellence, has many very commendable features. It contains complete descriptions of the Weston engine and all its parts, as well as valuable information about the operation and maintenance, and considerable data of a general character which cannot fail to interest central station men.

Aside from the "sky scrapers" which meet the gaze of the pedestrian coming down Adams street, Chicago, the word Okonite, in large black letters on top of the building occupied by the Central Electric company, cannot fail to attract attention. This sign was a familiar landmark on Franklin street for years and has doubtless set those not familiar with electrical matters to thinking. An inquiry addressed to the Central Electric company would soon enlighten them on the subject.

The expense of compiling and publishing a catalogue such as was recently issued by the Metropolitan Electric company, Chicago, is quite large, but the number of orders which have resulted from it, and received within the last few days alone, has exceeded the most sanguine expectations. The company's mail has been unusually large and catalogues have been sent to many prospective purchasers by request. Every electric light station, as well as those engaged in other branches of the industry should have one.

The Electric Appliance company, Chicago, is placing upon the market a complete magneto telephone system for private lines and office and factory exchanges. The principal feature of the system is the Acme magneto telephone, which is claimed to be superior to any other magneto phone that is being offered at anywhere near the same price. The company is at work upon a complete catalogue, which will be ready for distribution in a few weeks. Any applications for copies before publication will be gladly placed on file. The warm weather of last week has started a boom in the fan motor business, and the Electric Appliance company is busy filling orders for the Meston alternating current fan motor, for which it is western agent.

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The General Electric company reports the following orders for railway apparatus taken within a week from the New York office alone: Brooklyn, Queens County & Surburban company, 450 motors; Bridgeport, Conn., Traction company, 60 motors and a generator; Danbury, Conn., Street Railway company, 20 motors; New Haven, Conn., Street Railroad company, 20 moters and generator; Hartford, Conn., Street Railway company, eight motors; Allegheny Traction company, Pittsburg, Pa., 30 motors and generators; Jacob Rich, San Jose, Cal., two equipments and generators; W. R. Ferguson, Boston, generator; six motors to Franklin, Pa; Electric Traction company and Peoples' Traction company, Philadelphia, Pa., large marble switchboards.

ELECTRICAL PATENTS.

Issued May 15, 1894

519,715. Hand Regulator or Switch for Motors. E. E. Keller, Chicago, Ill.

519,726. Electric Arc Lamp. W. Mathiesen, Leipsic, Germany.

519,794. Electric Railway System. David Mason, Schenectady, N. Y.

519,813. Electrically Governed Switch. Emil H. E. Klatte, Freiburg, Germany.

519,837. Trolley Wheel. Van Dyke Cruser, Flatbush, N. Y.

519,849. Alternating Current Arc Lighting System. Thomas Spencer, Philadelphia, Pa.

This invention consists of an arrangement for supplying current to arc and incandescent lamps from the same alternating current. This is done economically by providing means for adjusting the voltage of the circuit to the best working point for the arc lamp irrespective of the voltage on the incandescent mains, and also raising the voltage for the arc lamp at the instant of starting, as a higher potential is required at the moment of starting than after the lamp is in service.

519,858. Constant Current Dynamo. W. H. Elkins, Cambridge, Mass.

519,862. Method of and Means for Starting Synchronous Motors. B. G. Lamme, Pittsburg, Pa.

Claim 3 reads as follows:

The combination of a constant potential alternating current system and a multiphase self-exciting synchronous motor, with a converter for each phase of said current having its primary in circuit with the main leads and its secondary in circuit with the motor armature, and means whereby the potential of the secondary circuits may all be symmetrically varied.

519,869. Electric Mechanism for Giving Reciprocating Motion. H. S. McKay, Boston, Mass.

519,870. Magnetic Engine for Reciprocating Tools. H. S. McKay, Boston, Mass.

519,876. Telephone Circuit. Charles E. Scribner, Chicago, Ill.

The invention provides means for avoiding the reproduction in a telephone receiver of sounds or accidental vibrations in its own microphone, without diminishing the efficiency of telephonic transmission. With this in view, accessory induction coils have been connected in the circuit with the telephone and microphone, and the circuit connections have been so arranged that during the transmission of outgoing telephonic currents the portions or points of the circuit between which the receiver of the sending station is connected are brought to a condition of no difference of potential; while, during the reception of incoming currents, the telephone of the same station is in the path of least resistance to them, and hence transmits and responds to them.

The following is one of the claims:

The combination in a telephone circuit divided into two parallel branches, of a bridge wire containing a telephone receiver uniting the two branches, two sources of telephonic current in each branch, one upon each side of the point of connection of the bridge wire with the same branch, one portion of each branch, upon opposite sides of said bridge connection, being constructed to have high impedance, and the electromotive forces of the different sources of current being adjustable to produce a condition of no difference of potential between the terminals of the said bridge connection, whereby outgoing telephonic currents are generated without affecting the telephone receiver, while incoming currents may be directed through the said receiver.

519,881. Device for Regulating Electricity Generated by Means of Wind Power. T. A. Willard, Norwalk, O.

519,912. Electric Arc Lamp. Jesse Kester, Buffalo, N. Y.

This invention relates particularly to carbon feeding mechanism and carbon holders for electric arc lamps, ordinarily termed gravity freed mechanism. The object of the invention is to produce mechanism of this class which will control the upper carbon in such a manner as to maintain a substantially constant arc, thus insuring the least possible variation of the light. Another object of the invention is to provide a magazine carbon holder, in which fragments of carbon sticks can be utilized, and a continuous light for a long number of hours can be maintained.

519,932. Electric Railway Signal. R. M. Strong and C. F. Reed, Omaha, Neb.

This invention relates to apparatus, by means of which engineers may be warned of misplaced switches or any obstruction on the track. Two pairs of conductors are carried along the whole length of the track and divided into sections of perhaps a mile. Each section being provided at intervals with contact basis to be bridged or connected momentarily by brushes carried by all passing engines, thus completing a circuit through a battery on the locomotive and one on the sections.

519,938. Electric Railway Signal. Frank Beattie, Leete Island, Conn.

519,945. Electric Indicator. Wilbur E. Garey, Chicago, Ill.

Eugene F. Phillips, Prest. W. A. Hathaway, Treas. W. H. Sawyer, Sec'y.

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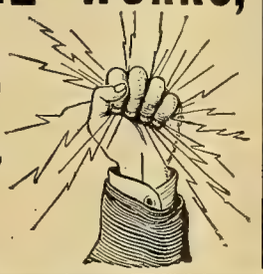

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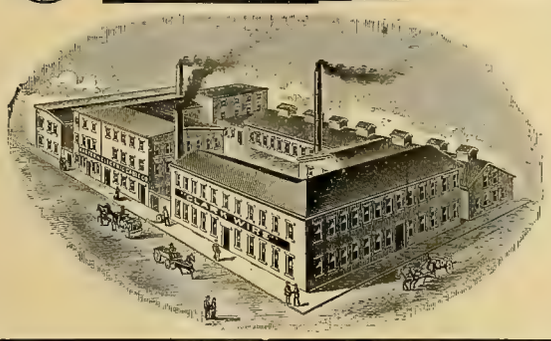

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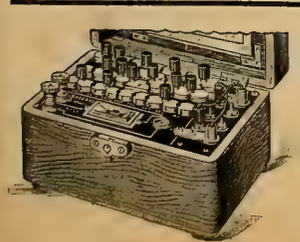

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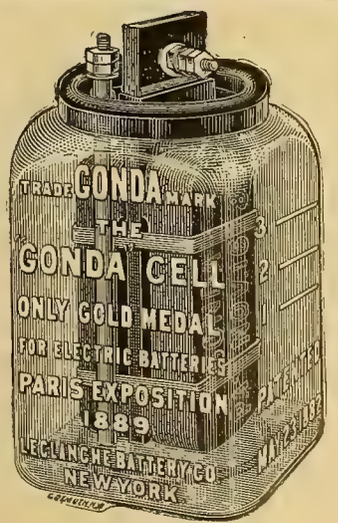

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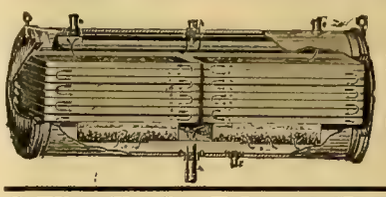

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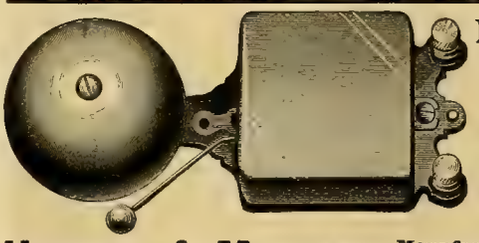

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Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, JUNE 2, 1894. No. 22

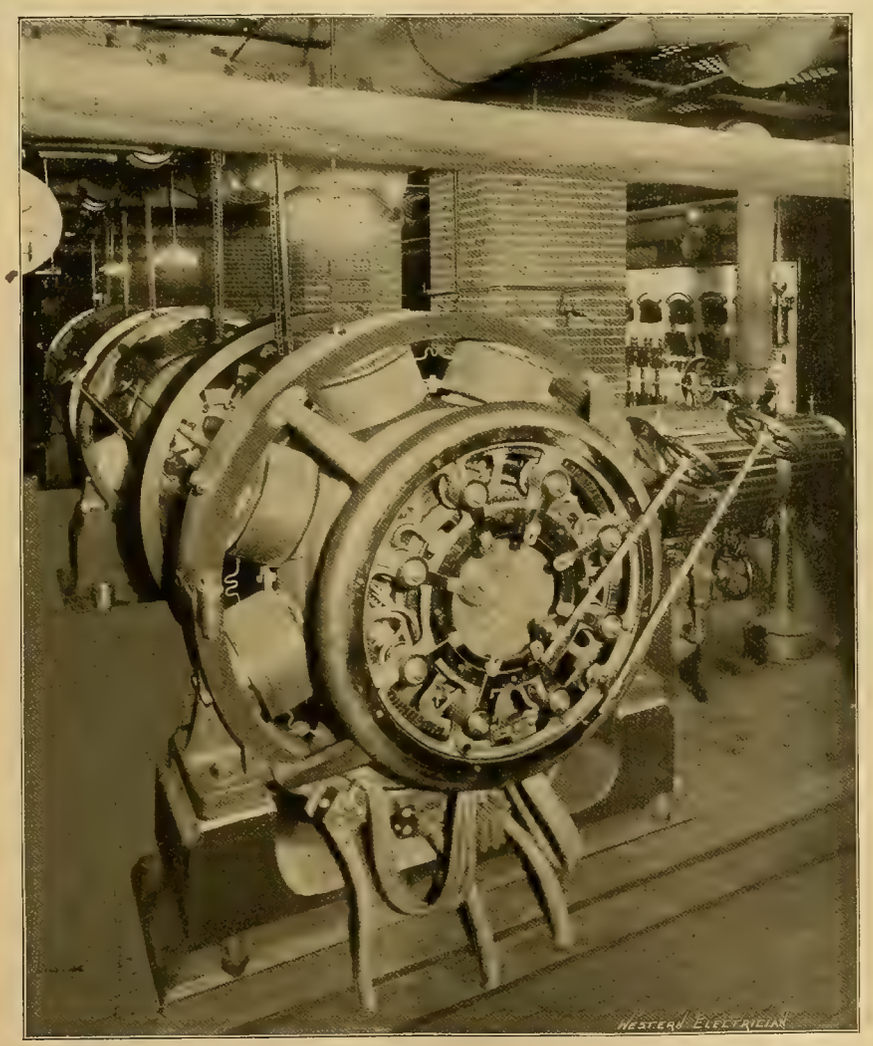
Chicago Stock Exchange Plant.

Directly connected plants for private lighting equipments are rapidly increasing in number. One of the latest to be put in operation in Chicago, and also one of the largest, is that in the new Stock Exchange building at La Salle and Washington streets. This plant, which is shown in the accompanying illustration, comprises three engine-dynamos, with a combined capacity of about 5,000 lamps. As is the almost universal custom in office buildings, the electrical machinery is to be found in the basement, but, although no space is wasted, the absence of belts and shafting takes away the cramped condition so frequently found in plants of this character, and the advantage of directly coupled units in this respect is made obvious.

The engines are tandem compound Ideals, rated at 150 horse power each, and directly coupled to the armature shafts in the manner shown in the illustration, making very compact combinations. The dynamos are eight-pole Edison machines, made by the General Electric company, and are wound for 100 kilowatts—800 amperes at 125 volts—each. They have iron-clad armatures and represent the latest development in multipolar incandescent machinery at the Schenectady shops, being the first machines to be supplied with the new brush-shifting device. Engine and dynamo are operated at 250 revolutions per minute.

From the dynamos the feeders are laid beneath the floor level in iron-covered trenches to the switchboard. The latter is of white marble, equipped with Weston shunt instruments. The connections are on the back of the board and are of bar copper, with studs and nuts of the same material. The building is wired for about 5,500 16 candle power lamps, and many of the fixtures, which were especially designed by Architect L. H. Sullivan, are unique and attractive. This is especially the case in the stock exchange itself, which is handsomely decorated, with fixtures to correspond. Interior conduit tubing is used in the walls, while in the rooms and halls the wiring is concealed behind mouldings. A noticeable feature of the office lighting is an improved wall bracket arranged to drop from the moulding to the proper height. As this fixture contains its own conductors a side light can be obtained at a convenient height at any part of the room by tapping the circuit in the moulding above and without marring the plaster. Three Crocker-Wheeler motors are operated from the lighting mains—two of 25 horse power each in the attic, driving ventilating fans, and a 10 horse power machine in the basement for the same purpose. These motors are provided with field regulators, and the speed is controlled at will by this means.

The plant was installed by the Chicago Edison company and designed by L. A. Ferguson, the company's electrical engineer. It is operated by H. J. Blaney, the power superintendent of the building.



CHICAGO STOCK EXCHANGE PLANT.

An ordinance appropriating $110,000 for the establishment of an electric lighting plant by the city of Philadelphia is being considered.

Experiments with the Heilmann Electric Locomotive.

The Heilmann electric locomotive, illustrations of which appeared in this journal over a year ago, and which has attracted so much attention lately among electrical and railroad men, has been making some trial runs which are of interest. One is reported to have been made upon the road between Havre and Benzeville, France. The train traveled from Benzeville to Havre at the rate of 80 kilometers an hour, and the return journey from Havre to Benzeville, notwithstanding a steep gradient which had to be encountered, was affected at the speed of 100 kilometers an hour. Another experiment which took place some time ago was made upon the Western railway of France between Paris and Nantes. The train consisted of the locomotive, five carriages and a brake van, and it covered the entire distance, 33 miles, in 55 minutes. It is stated that a speed of 55 miles an hour was attained on certain parts of the journey.

The Cataract Electric Company.

The announcement is made that the Cataract Electric company, which succeeded in getting a franchise from the state of New York permitting the use of the banks of the Erie canal upon which to string its wires from Buffalo to those cities in which it is intended to use electrically transmitted power from Niagara Falls, has begun the formation of a number of smaller companies to control and manage the business in those places. A company has already been incorporated in Buffalo, and other companies are contemplated in Rochester, Syracuse and Albany. A fifth company, known as the Erie Traction company, has also been organized. In the formation of all these companies the controlling interest is held by members of the Cataract company, and local men are given a voice and interest therein.

Electrical Fishing.

An interesting device to the angler that secures his fish through a hole in the ice is one that, while eminently adapted to fishing through the ice, is good for use all the year round, irrespective of time or season. It is well known that the best way to attract fish at night is by a light of some kind, and that if the light can be thrown at will to any spot under the water, without appearing too prominently on the surface of the water, success is assured.

It is also fairly well known, says the *Philadelphia Inquirer*, that the Prince of Monaco, in Europe, is one of the most scientific and enthusiastic deep water fishermen that the world of sport holds today, to such an extent that a few years ago he invented a deep-water fish trap which could be sunk to a depth of two miles. This was provided with electric lights and a plunge battery, which had to be protected against the pressure of the water by large air cushions, and then when the trap was sunk he could at will turn on the current, get the light at that depth, and so catch fish, many of which had never been seen before.

This is all by the way. It is more the germ to a more useful and only general machine, one for every one to build or handle for himself. The device is a small incandescent lamp of about three candle power, having a piece of fine wire twisted around it to keep it from shaking against the sides of the quart bottle in which it is placed, which large bottle is weighted with lead so that it will sink to any depth required. Attached to the tiny lamp and passing through the cork or stopper are two lightweight electric wires covered with insulation of a light brown color (this being the invisible hue for water work, and not gray, as so many people erroneously imagine).

These wires run upward to any desired length, and the depth of the lamp in the water is regulated by a large board float, the wires passing into the boat, where there is a small battery, cunningly fitted into a box. By the pressing down of a handle the circuit is made, and the light glows at any desired depth, attracting the fish from a distance and undoubtedly productive of good sport. The cost of the outfit is $37, but a home made one can easily be put together by anyone having a smattering of technical and practical electrical knowledge for about $5, one and that would answer just as well as far as producing a light and attracting the fish is concerned.

It would appear that with this light under the water and "tip-ups," the clear winter night overhead, and the clear red fire merrily blazing on the bank, and the pan ready for any fish that may be caught, there is all the necessary material for any amount of fun in the winter, for the one great drawback to fishing through the ice has always been the unwritten law that it is a daylight sport, and that as soon as night falls it is "up lines" and home.

It is perhaps as well to say that if the best results are desired with any kind of ice fishing, the ground must be baited for two or three days in advance.

The Waterport, N. Y., Electric Light & Power company has been formed to furnish power and light to the town of Waterport. John C. Hale of Batavia, N. Y., is interested in the scheme. The capital stock is $40,000.

Street Railway Track Construction.

The accompanying cut illustrates an interesting piece of track construction, recently completed at Rochester, N. Y. Owing to the peculiar conditions under which the street railway system was laid out, all the lines pass a central point in the heart of the business district, known as the "Four Corners." The Rochester Railway company has just completed a new track at this point weighing 50,000 pounds, and costing $10,000. The entire track work at the "Four Corners" rests upon heavy ties which are firmly imbedded in a foundation of broken stone, sand and cement. The rails leading from the corners east and west on Main street weigh 93 pounds per yard.

Discriminating Lightning Arresters, and Recent Progress in Means for Protection Against Lightning.[1]

By Alexander Jay Wurts.

PART I.—AN EXPERIMENT WITH LIGHTNING ARRESTERS ON A 3,000 VOLT ALTERNATING CURRENT CIRCUIT.

The general requirements of efficient lightning arrester apparatus are: First, to provide discharge circuits which shall operate automatically and repeatedly, and which shall with certainty avoid dynamo short-circuits or interruption of the system; second, to provide discharge circuits, or so install them that they shall invariably offer a certain path to ground for disruptive discharges in preference to any other part of the system. It follows also from this last, and as a matter of practical experience, that ground discharge circuits should be short and straight, and that ground connections should be of the most improved construction.

The difficulties in the way of meeting the above requirements on circuits of high potential seemed at first somewhat serious, in view of the fact that many of the arresters already used had not only been instantly destroyed by the short-circuiting which follows each discharge, but, in many instances, the arresters had been entirely ignored by the lightning, the discharges preferring an armature or converter to the spark gaps of the arresters. The correct method for overcoming this latter difficulty is to equip the system with a liberal distribution of line arresters, which, by thus affording frequent opportunities for discharge along the line, will greatly lessen the probabilities, or rather necessity, for discharging in the station. Parts requiring protection in the power transmission plants upon which the experiments were conducted were confined to the ends of the circuits, so that it became possible to adopt the following general plan, namely: to provide, first, an abundant discharging capacity from the line immediately before entering the station or power houses, and, second, to interpose between this point and the parts to be protected such a resistance to disruptive discharges as should make it a matter of necessity rather than of choice for these discharges to pass to earth over the discharge circuits provided for them.

The only apparatus which seemed at all available for this work was the non-arcing metal lightning arrester and some efficient form of choke coil which might be connected in the circuit between the arresters and the apparatus to be protected. As is well known, the 1,000 volt non-arcing metal lightning arrester, which is now almost universally used on alternating current circuits, consists essentially of seven non-arcing metal cylinders arranged side by side with 1-64 inch spark gaps intervening. The two outside cylinders are connected to the respective sides of the circuit and the middle cylinder to the ground, thus forming a double pole arrester. For higher voltages, however, the number of cylinders must be increased in order to prevent the dynamo current from following in the path of disruptive discharges. Experiments were made, therefore, to determine the number of non-arcing metal cylinders and spark gaps which would be necessary to interupt a short-circuit on a 3,000 volt alternator with the potential raised to 3,300 volts. Nineteen cylinders, or 18 gaps, were found to offer ample margin, and the breaking down electromotive force on half this number of gaps, which would intervene between line and ground, was found to be about 70 per cent. of the electromotive force required to break down insulation ordinarily used in a 3,000 volt generator.

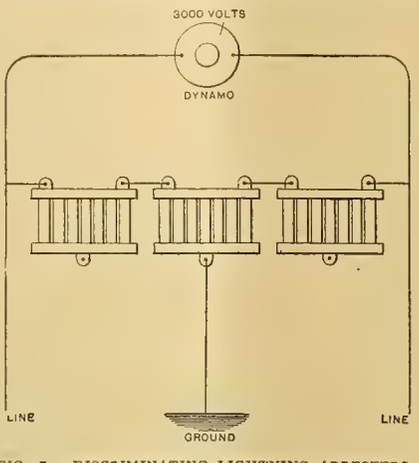
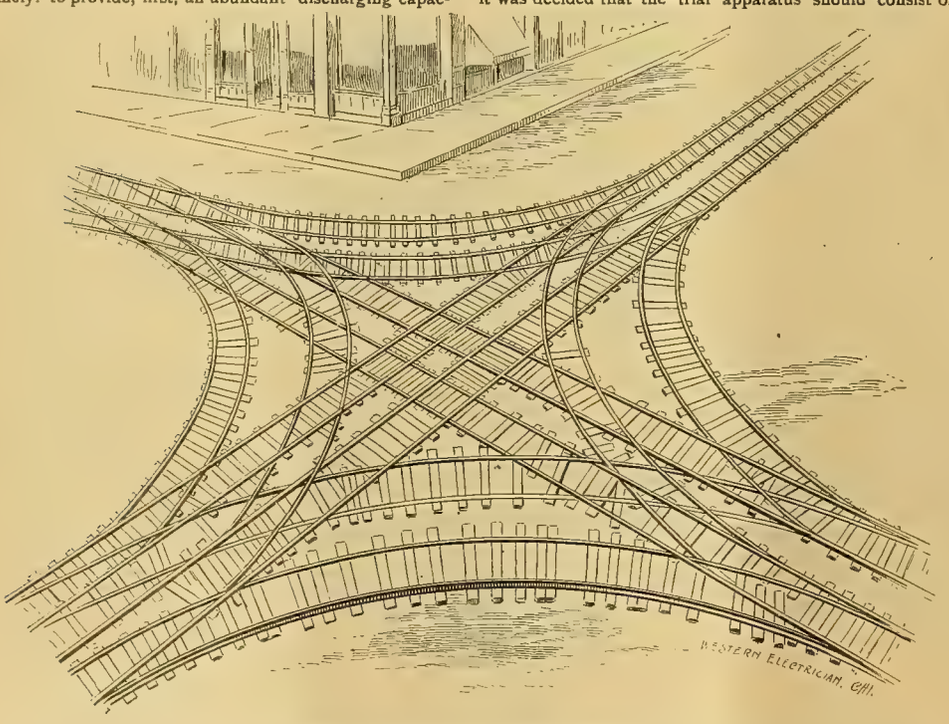


FIG. 1. DISCRIMINATING LIGHTNING ARRESTERS.

Three 1,000 volt non-arcing metal arresters, Fig. 1, were, therefore, selected as offering a convenient means of installing this apparatus. It is also well known that coils and even sharp turns in a wire offer a high inductive resistance to disruptive discharges. Various forms of choke coils were, therefore, constructed and tested with the idea of determining those proportions which, for present requirements, should offer maximum impedance with a given length of wire. These experiments will be more particularly described in Part II. The form finally adopted was that of a flat coil about 18 inches in diameter, and wound with 17 turns of wire; the size of the wire varied, of course with the carrying capacity of the particular circuit into which it was to be connected. After further experimenting with various combinations of spark gaps and choke coils, it was decided that the trial apparatus should consist of eight choke coils and twelve 1,000 volt non-arcing metal arresters for each end of each circuit; that is, four choke coils should be connected in series in each leg of each circuit, with discharge circuits intervening. The relative positions of these parts are clearly indicated in Fig. 2, which represents one end of each of three circuits.



STREET RAILWAY TRACK CONSTRUCTION.

The theory upon which the selection of this apparatus was based will be more generally discussed in Part II.; suffice it to say here that disruptive discharges form nodal points in the system, that is, points where there will be a minimum tendency to discharge; hence, to avoid these with any degree of certainty a multiplicity of arresters, preferably line arresters, should be used. Choke coils form points of reflection, or points where there will be a maximum tendency to discharge—hence a discharge spark gap connected directly in front of a choke coil is more likely to receive discharges than if placed at some other point in the system. Properly constructed choke coils also offer a very high resistance to the passage of disruptive discharges, so that if one or more such coils be connected between a discharge circuit and the apparatus to be protected, and if the discharge circuit or ground wire be short and straight, the probabilities of safe discharge to earth will be vastly increased. Further, disruptive discharges are liable to divide and follow several paths, being governed by a complexity of ever-varying circumstances. For this reason it was decided to connect several choke coils in series, so that should only a portion of a discharge pass across the first arrester, the balance passing through the first coil, a second opportunity for discharge would be found at the second arrester, which was also connected in front of a coil, and, therefore, at a point of reflection. Should this remaining portion of the discharge again divide, a further opportunity for discharge would be afforded at the third arrester, and so on, so that by the time the fourth coil was reached it was presumed that the discharge would have spent itself.

Some of the many experiments made to substantiate this theory are exceedingly interesting as well as instructive. Referring to Fig. 3, A are the terminals of a powerful influence machine, B is a battery of Leyden jars, G a wire which may represent the ground, and is connected to the outside coating of the jars; L is a second wire, which may represent one leg of an electric circuit; a, b, c and d are choke coils connected into the line L, and in series with each other; 2, 3, 4 and 5 are intervening discharge circuits containing spark gaps; 1 is a 12-32 inch spark gap separating line L from the inside coating of battery B. If now the battery becomes charged from the influence machine A, a large and violent disruptive discharge will take place across gap 1 and suddenly charge line L. This discharge will then pass to earth G through one or more of the spark gaps 2, 3, 4, 5, according to circumstances. It will be noted now that this arrangement of choke coils and discharge circuits is similar to that shown in Fig. 2. The spark gaps were made of rounded half-inch brass rod adjustable with a 1-32 inch screw thread. The coils were wound with No. 0000 wire, were 3 inches in diameter, 6 inches long and contained 11 turns each.

The following table indicates the very interesting results obtained by varying the lengths of spark gaps 2, 3, 4 and 5. The signs "—", "*" and "0" indicate, respectively, a heavy discharge, a feeble, thread-like discharge and no discharge.

The Spark Gap Numbers	1	2	3	4	5
The Spark Gap Lengths	12	14	1	1	1
Results, 1st	—	—	*	0	0
" 2nd	—	0	—	0	0
The Spark Gap Lengths	12	14	2	1	1
Results	—	0	—	*	0
The Spark Gap Lengths	12	14	2	2	1
Results	—	0	—	0	*
The Spark Gap Lengths	12	14	2	2	2
Results	—	0	—	0	0
The Spark Gap Lengths	12	14	3	2	2
Results	—	0	—	*	0
The Spark Gap Lengths	12	14	3	3	2
Results	—	0	—	0	*
The Spark Gap Lengths	12	14	3	3	3
Results	—	0	—	0	0
The Spark Gap Lengths	12	14	4	3	3
Results, 1st	—	—	0	*	0
" 2nd	—	0	—	*	0
The Spark Gap Lengths	12	14	4	4	3
Results	—	0	—	0	*
The Spark Gap Lengths	12	14	4	4	4
Results, 1st	—	—	*	—	0
" 2nd	—	0	—	0	0
" 3rd	—	0	0	—	0
" 4th	—	0	—	*	0
The Spark Gap Lengths	12	14	5	4	4
Results, 1st	—	0	—	0	0
" 2nd	—	—	0	0	*
" 3rd	—	—	—	—	0
" 4th	—	0	0	—	0
" 5th	—	0	—	0	*
The Spark Gap Lengths	12	14	5	5	4
Results, 1st	—	—	—	0	*
" 2nd	—	—	0	0	*
" 3rd	—	0	—	0	*
The Spark Gap Lengths	12	14	5	5	5
Results, 1st	—	—	—	0	0
" 2nd	—	—	0	0	0
" 3rd	—	0	—	0	0
" 4th	—	—	0	0	*
" 5th	—	—	0	0	*
" 6th	—	0	0	—	0
" 7th	—	—	—	0	0
Spark Gap Lengths	12	16	5	5	5
Results	—	0	—	0	*
The Spark Gap Lengths	12	16	6	5	5
Results, 1st	—	—	—	—	0
" 2nd	—	—	0	—	0
" 3rd	—	0	—	0	0
" 4th	—	0	0	—	0
The Spark Gap Lengths	12	16	6	6	5
Results, 1st	—	0	—	*	0
" 2nd	—	0	—	0	*
" 3rd	—	—	—	0	*
The Spark Gap Lengths	12	16	6	6	6
Results, 1st	—	0	—	0	*
" 2nd	—	0	—	0	0
" 3rd	—	0	—	0	*
The Spark Gap Lengths	12	16	9	6	6
Results, 1st	—	—	—	—	0
" 2nd	—	—	—	0	*
" 3rd	—	—	*	0	0
" 4th	—	—	0	—	0
The Spark Gap Lengths	12	16	10	6	6
Results, 1st	—	0	*	—	0
" 2nd	—	—	0	—	*
The Spark Gap Lengths	12	16	11	6	6
Results	—	0	0	—	*
The Spark Gap Lengths	12	16	10	10	10
Results, 1st	—	—	—	—	0
" 2nd	—	—	—	0	*
" 3rd	—	—	—	0	0
The Spark Gap Lengths	12	20	10	10	10
Results, 1st	—	0	—	—	0
" 2nd	—	0	—	0	*
" 3rd	—	0	—	*	0

When 1 = 12, 2 = 9, 3 = 5½, 4 = 3¾ and 5 = 1, the sparks were about evenly divided, except that 5 never sparked alone and always gave thread-like sparks when 2 sparked. These results are represented graphically in Fig. 4.

Glancing now at the table we notice: First, the difficulty

1. Abstract of a paper read at the eleventh general meeting of the American Institute of Electrical Engineers, Philadelphia, May 16, 1894.

that disruptive discharges experience in passing the coils, jumping as they do large air gaps in preference to the more circuitous but infinitely better conducting paths afforded by the coils; second, the tendency for discharges to divide into two or more paths, part passing across the first or second gap and the remainder through one or more coils to a succeeding gap, showing thereby that a single choke coil does not offer certain security against the passage of these discharges; third, the uncertainty of the paths that will be selected during a series of tests where the conditions are maintained as nearly constant as possible; in fact, it seems almost impossible to produce the same results twice in succession. It is, however, to be noticed that with these four choke coils in series and spark gaps intervening, the discharges are so thoroughly sifted out that only an occasional thread-like spark finds its way across the last gap. With laboratory results such as these,

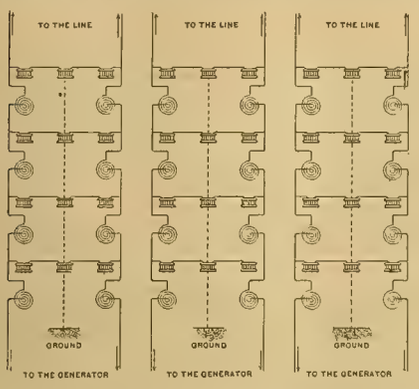


FIG. 2. DISCRIMINATING LIGHTNING ARRESTERS.

it seemed fair to presume that results more or less similar might also be expected in practice.

The plant selected for the trial of this apparatus was that of the San Miguel Consolidated Gold Mining company of Telluride, Colorado, which is equipped with a 3,000 volt alternating current synchronous system, operating stamping mills and furnishing current to the Telluride Electric Light company. These points are situated among the mountains at distances varying from three to ten miles from the power house. Three separate circuits leaving the power-house extend over a wild and rocky country and in some places rise above timber line. In previous years every attempt to protect this plant from lightning had failed. During the summer months two horses were kept constantly saddled ready for emergencies consequent on lightning discharges, and at the motor and power house it was common practice on the approach of a thunder storm to lay out, ready for instant use, an extra armature coil, with all the necessary tools for handling the same. In one of the former types of arresters used in this plant forty fuses were blown inside of 60 minutes.

The location of each bank of arresters was selected with particular reference to securing permanently damp earth for the ground plate, the lines being led to this spot. The circuit was thus made to accomodate itself to the arresters, rather than the arresters to the circuit. The apparatus was then installed in a specially constructed and weather-proof lightning arrester house, Fig. 5, the arresters and choke coils being mounted on thoroughly dried wooden frames and every precaution taken to insulate these from the ground and from each other. In this manner also it was expected that the lightning discharges would be kept entirely out of the station.

The connections inside the power house lightning arrester house are all clearly indicated in Fig. 2. One main B. and S. No. 3 ground wire was used for all the arresters in each bank, unnecessary kinks and bends being studiously avoided,

The grounds which I used were of the most approved construction, and in this respect were in marked contrast to ground connections commonly found in practice. An old rusty casting or an abandoned pulley hooked onto the end of a tangled piece of scrap wire, and then thrown into a neighboring creek or the tail race of a mill, or a small

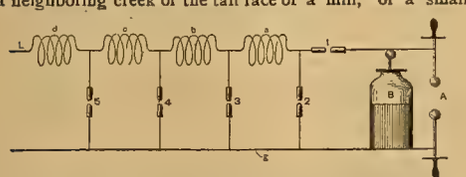


FIG. 3. DISCRIMINATING LIGHTNING ARRESTERS.

iron spike driven conveniently into dry earth or sand, form ground connections not infrequently found in practice. But my work being only of a experimental nature, a thoroughly good ground connection was thought to be one of the essentials. The ground connections were therefore made as follows: First, a hole six feet square was sunk directly under each bank of arresters until permanently damp earth was reached; second, the bottom of this hole was covered with two feet of crushed charcoal (about pea size)—crushed coke would have answered equally well; third, over this was laid 25 square feet of No. 16 copper plate; fourth, the ground wire was then firmly soldered all the way across the ground plate; fifth, the plate was now covered with two feet of charcoal; and sixth, the hole then filledin with earth, using running water to settle. In one instance permanently damp earth could not be reached water was therefore brought from some considerable distance through an iron pipe and run into the upper earth of the ground hole. In this manner the entire ground construction was maintained constantly damp.

Observations were taken by competent men at each bank of arresters during the entire lightning season, and the results obtained indicate that the discharges occurred most frequently over the second arresters; many passed over the third arresters; very few, however, over the first or fourth. The writer personally watched one of these banks of arresters through severe thunder storms, and in every instance the discharges noticed by him were seen to pass across the second series of spark gaps. The discharges followed each other across the cylinders with great rapidity, making peculiar and often startling sounds, very similar to the cracking of a teamster's whip, but in no instance was there a fuse blown or damage done to the arresters. Now, these facts are not only of great practical importance, but are also exceedingly interesting when studied in connection with the results already mentioned as having been obtained with choke coils and spark gaps in my laboratory experiments. At the end of the lightning season the non-arcing metal cylinders of the arresters were carefully inspected, and the confronting sides found to be covered with minute black spots where the discharges had passed from cylinder to cylinder. These spots were often centered with very small, smooth exposures of the metal, but in no instance was there any indication of beading or fusing together of the adjacent cylinders.

The net results of this lightning arrester experiment are most satisfactorily summed up in the following abstract from a letter written by P. N. Nunn, electrical engineer of the San Miguel Consolidated Gold Mining company. I feel greatly indebted to Mr. Nunn for the kindly assistance he has rendered in carrying out these tests, and take this opportunity to again thank him for his valuable suggestions and the painstaking care with which the installation was made.

"At the present time, as you are aware, our plant consists of a power station at Ames, equipped with Westinghouse alternating current generators of 1,100 horse power capacity, which supply current for synchronous motors in three stamp mills at a distance of two, three and ten miles respectively, and for lights in the town of Telluride, about eight miles distant. The pole line runs over the mountains in altitudes varying from 8,800 to 12,000 feet above the sea level, traversing at different places bare ridges of mountain divide and large tracts of magnetic mineral. It is thus peculiarly exposed to lightning in a district where lightning is of extraordinary frequency and force at certain seasons of the year.

"The difficulties of the situation are further aggravated by the fact that we generate and utilize without transforma-

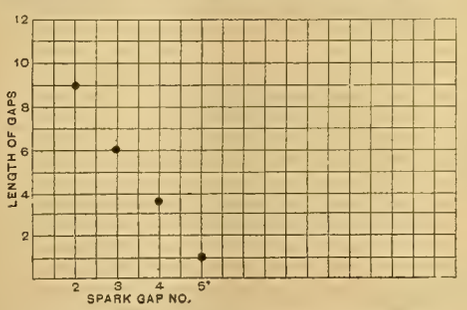


FIG. 4. DISCRIMINATING LIGHTNING ARRESTERS.

tion, except for lighting purposes, an alternating current of 3,000 volts.

"Despite the use of an overhead grounded wire on our pole line, and the best arresting apparatus we could procure, we suffered continual interruptions during the lightning seasons of 1891 and 1892. On one occasion five armature coils were burned out in a single storm. With any other form of armature this would have meant five burned-out armatures; but with the toothed armature of your machines it represented the cost of five new coils and a day's delay. The frequency of the discharges of lightning was so great that the insulation in the highest grade of cables and cores throughout the entire apparatus became so honeycombed with perforations as to give rise to continual leakage, grounds and short-circuits, requiring constant and expensive repairs and causing prolonged delays.

"Since putting in your non-arcing metal arresters in connection with your system of specially designed choke coils, we have passed through the lightning season of 1893 without a particle of lightning having passed to our knowledge beyond the arresting apparatus, without a shut-down, without the loss of a coil, and without a single perforation of insulation. The experience of this season has given us the greatest confidence in the efficiency of your apparatus as a protection against lightning."

PART II.—PROTECTION AGAINST LIGHTNING ON CIRCUITS OF ANY POTENTIAL.

A system of protection against lightning discharges has been designed by the writer which is applicable to circuits of any potential, and although this system has not yet received a practical test, the indications are that it will prove efficient.

The proposition is to connect in series with the circuit, and at frequent intervals, a system of properly constructed choke coils, the expectation being that the energy stored in the circuit in the form of static electricity will, at moments when there is a tendency to a disruptive discharge, dissipate itself into heat through the electrical surgings which will be set up between and among the several choke coils. In Fig. 6 there is represented a power transmission circuit provided with this system of protection against lightning.

A curious freak which came under my observation last summer is illustrated in Fig. 7. T represents an overhead trolley wire, on either side of which are wooden poles. H is a bell-shaped insulator made of compressed mica and shellac. These insulators easily withstand an electric strain of 12,000 volts. R is an iron ring holding the span wire to the pole. B is a branch circuit feeding current to a group of lamps G^1, and L is a lightning arrester in its discharge circuit. G^2 is a second group of lamps. The distance between H and B is about 50 feet. After a violent thunder storm it was noticed that one of these poles had been shattered from the top down to the iron ring, the remaining portion being uninjured. This had been done by lightning, and in the opinion of the writer, by one of the ramifications to which allusion has already been made. In any case, this discharge, whatever it may have been, passed over the span wire to the bell insulator H, piercing it and breaking it into three pieces, then traveled along the trolley wire to B, where it apparently divided, one part passing to the group of lights G^2, breaking them all, ten in number, and the other part to earth through the arrester L, without in any way interfering with the group of lights G^1. It is quite remarkable to note that none of the parts damaged by this discharge showed any indications of heat.

During last summer I watched many discharges enter a

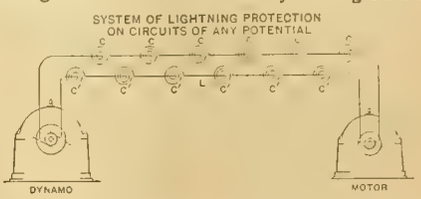


FIG. 6. DISCRIMINATING LIGHTNING ARRESTERS.

generating station over dead wires and pass to earth across simple carbon spark gaps provided with No. 18 copper wire fuses. The discharges gave a crackling sound similar to that of discharges from a Leyden jar, and in some instances where I had placed pieces of tissue paper between the electrodes of the spark gaps, the papers were perforated with small holes. In one instance only which came under my observation did the copper wire fuse let go. An apparently prolonged discharge passed over one of the spark gaps with a hissing sound, raised the tips of the carbon electrodes to a white heat and fused the copper wire cut-out, the time taken being approximately two seconds, which would indicate in the neighborhood of 150 amperes. I believe this discharge to have been part of a true lightning discharge—one of its ramifications—but in the great majority of cases the discharges are small, and in this respect bear no comparison to cloud discharges.

Now, if the "electrical surgings" theory be correct, I believe that these dangerous points of reflection can, by means of properly distributed and effective choke coils, be confined to long lines and made to wear themselves out, as it were, between the coils. In this manner frequent points of reflection would be distributed over the system. Primary waves set up during electrical disturbances would be broken into smaller waves, which, surging back and forth between the coils or points of reflection, would finally become dissipated and their energy pass off into heat.

The number of coils which it would be necessary to use for a given length of circuit has not yet been determined, but the writer would suggest placing four to each mile of single wire. For convenient accommodation on the poles these can be arranged alternately on the two legs of the circuit, thus avoiding two coils on any one pole.

Should such a system of protection against lightning be found efficient, its many advantages over the discharge circuit method would be obvious, particularly in a country where good ground connections are costly, and often impossible to construct.

The general form and dimensions of these choke coils is a matter of considerable importance. Dr. Lodge states, I believe, that for disruptive discharges a flat spiral will offer maximum impedance with a given length of wire. To the best of my knowledge, however, Dr. Lodge makes no mention of the number of turns which may be advantageously used. I have found by experiment that the impedance does not continuously increase with the number of turns, but that a critical point is rapidly reached,

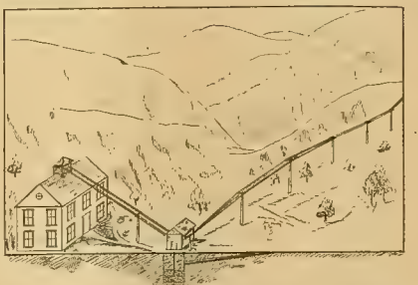


FIG. 5. DISCRIMINATING LIGHTNING ARRESTERS.

beyond which additional turns do not add appreciably to the impedance of the coil. The critical point was determined in the following manner. A large flat coil was constructed, having the following specifications:

Size of wire	No. 0
Number of turns	34
Outside diameter	30"
Inside	3"

The wire was carefully insulated so that the discharges could not pass between consecutive convolutions.

This coil was then connected up in the usual manner for determining impedance, the general arrangement of the apparatus being shown in Figs. 8, 9, 10 and 11, where B is a variable shunt spark gap, one terminal of which is permanently connected to either terminal of the coil, while

the other is provided with a sharp metallic point fastened to a short flexible cord. The sharp point was used to pierce the insulation of the coil, thereby reaching the copper of any convolution and also in this manner providing a means for shunting any desired portion of the coil by the spark gap B. Spark gaps A and B were varied by means of a thirty-second of an inch screw thread, so that the dimensions of these gaps are given in thirty-seconds of an inch.

Each determination was made by shunting with the gap B that portion of the coil whose impedance was desired, and then varying the length of B until the diseharges were about evenly divided between the coil and the gap. In the following table are given the values of B and the number of convolutions shunted by the gap in each determination:

No. of Turns.	1st B	2nd B	3rd B.	4th B	5th B
1	¼	2	¼	½	½
2	1	3½	1	1	1½
3	1½	5½	2	2	2½
4	2½	6½	3	3	3½
5	3½	8½	4	4	4½
6	3½	10½	5	7	6
7	3½	11	5½	9	6½
8	4½	11	6½	11	7½
9	5½	11	7	13	8½
10	6	11	7½	14	9½
11	6½	11	8	15	10½
12	7	11	9	17	11½
13	7½	11	9½	18	13
14	8	11	10	20	13
15	8½	11	11	20½	13
16	9	11	11½	20½	13
17	9	11	11½	20½	13
18	9½	11	11½	20½	13
19	10½	11	11½	20½	13
20	10½	11	11½	20½	13
21	10½	11	11½	20½	13
22	10½	11	11½	20½	13
23	10½	11	11½	20½	13
24	10½	11	11½	20½	13
25	10½	11	11½	20½	13
26	10½	11	11½	20½	13
27	11	11	11½	20½	13
28	11	11	11½	20½	13
29	11	11	11½	21	13
30	11	11	11½	21	13
31	11	11	11½	21	13
32	11	11	11½	21	13
33	11	11	11½	21	13
34	11	11	11½	21	13

In the first column are given the number of couvolutions shunted by the spark B.

Column 1 B gives the values of B under conditions shown in Fig. 10, with A equals 12 and with rounded electrodes at B.

Column 2 B gives the values of B under conditions shown in Fig. 9, with A equals 12 and with rounded electrodes at B.

Column 3 B gives the values of B under conditions shown in Fig. 11, with A equals 12 and with rounded electrodes at B.

Column 4 B gives the values of B under conditions shown in Fig. 12, with A equals 12 and with sharp electrodes at B.

Column 5 B gives the values of B under conditions shown in Fig. 11, with A equals 15 and with rounded electrodes at B.

For convenience, these results are graphically represented in Figs. 12, 13, 14, 15 and 16, and we note, first, that in each case a positive maximum impedance is reached, beyond which additional turns do not affect the results; second, that with the exception of the results shown in Fig. 12, the impedance does not increase beyond about the 17th turn; third, that with both terminals of the coil permanently connected to the discharge circuit, Fig. 12, the increase of impedance is more gradual than when only one terminal is so connected; fourth that when permanent connection is made to the outside of the coil, Fig. 13, the increase is more rapid than when permanent connection is made at the center, Fig. 14; in other words, a single turn on the outside offers more impedance than a single turn nearer the center; for equal lengths of wire, however, the turns near the center offer greater impedance; fifth, that increasing A slightly decreases the number of turns, Fig. 16; sixth, that using points at B, instead of knobs, does not materially change the results, other than to make the path selected by the discharge somewhat more uncertain, as will be noticed by the irregular curve shown in Fig. 15. The coils which I have constructed have been wound with reference to the critical point.

Dr. Lodge has also experimented with such coils in connection with iron cores, and fcund that the impedance is not appreciably affected by their introduction. I have

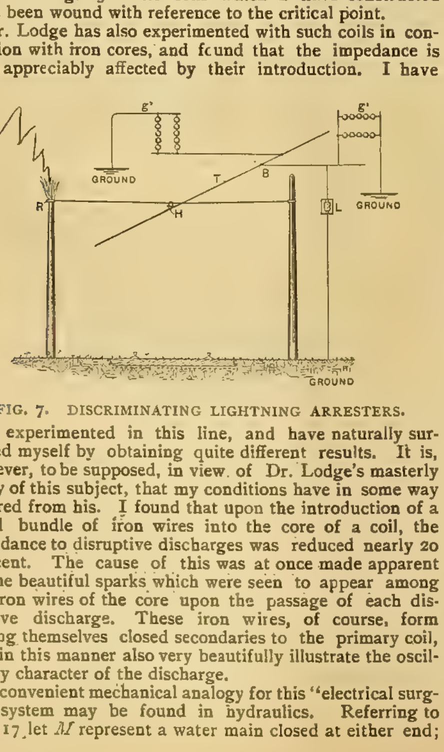


FIG. 7. DISCRIMINATING LIGHTNING ARRESTERS.

also experimented in this line, and have naturally surprised myself by obtaining quite different results. It is, however, to be supposed, in view of Dr. Lodge's masterly study of this subject, that my conditions have in some way differed from his. I found that upon the introduction of a small bundle of iron wires into the core of a coil, the impedance to disruptive discharges was reduced nearly 20 per cent. The cause of this was at once made apparent by the beautiful sparks which were seen to appear among the iron wires of the core upon the passage of each disruptive discharge. These iron wires, of course, form among themselves closed secondaries to the primary coil, and in this manner also very beautifully illustrate the oscillatory character of the discharge.

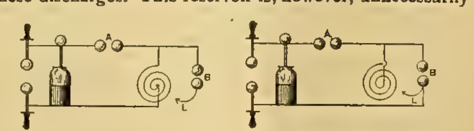
A convenient mechanical analogy for this "electrical surging system may be found in hydraulics. Referring to Fig. 17, let M represent a water main closed at either end; $F F$ a supply and outlet; $d d$, etc., perforated elastic diaphragms. If now an impulse be imparted to the water at E, as by a blow, a wave will tend to travel from one end of the main to the other, and if it were not for the diaphragms, this wave would either burst out the opposite end of the pipe or be reflected back and forth until the energy of the wave had become transformed into heat. The presence of the diaphragms, however, will tend to break up the initial wave and confine the surgings to comparatively small portions of the pipe. At the same time the perforations in the diaphragms allow of a continuous flow of water under pressure. In the electrical system the choke coils are supposed to break up the electrical surgings, much as these diaphragms break up the water surgings, and at the same time the coils do not materially interfere with the passage of the dynamo current. The coils cause points of reflection to occur where an excessive static strain can do no harm. The ends of the circuit, which are the vital parts of an electric power transmission system, are thus shielded by the coils, and the energy of the static charge is harmlessly transformed into heat.

It has, however been mentioned in Part I. that coils are not absolutely impervious to disruptive discharge. A discharge entering a coil meets with continuous resistance and is finally all or partially reflected; in other words, a coil is not a stone wall, does not necessarily confine the point of intense electrical strain to the first inch or two of the coil. The discharge penetrates the coil and often causes "side flash" to occur well within its interior. In my mechanical analogy, therefore, I have represented this yielding opposition, as it were, by elastic diaphragms.

PART III.—DISCRIMINATING LIGHTNING ARRESTERS.

The Condenser Lightning Arrester.—The discovery and practical application of non-arcing metal to alternating current circuits about two years ago,[1] has indicated the possibility of constructing a discriminating lightning arrester, as it were, for direct current circuits; that is, an arrester which should not require the usual automatic circuit interrupting attachment, but which, by virtue of its material or construction, should allow static electricity to pass and prove an effectual barrier to the dynamo current.

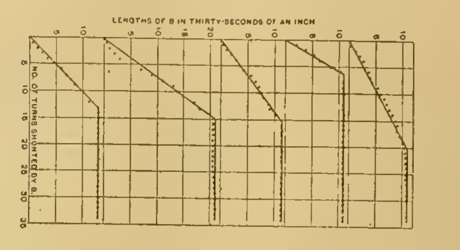
The first step taken in this direction was to carefully analyze the conditions, and the general conclusions arrived at were as follows: A circuit becomes charged in various ways with static electricity tending to earth. These charges are, in a majority of cases, small and of no considerable intensity. The surgings in the system find points of reflection which also become points of greatly increased tension. The earth is the great reservoir (to use common language) for these discharges. This reservoir is, however, unnecessarily



FIGS. 8 AND 10. DISCRIMINATING LIGHTNING ARRESTERS.

large for the accommodation of line discharges. Might not smaller reservoirs be made—little earths insulated from the mother earth? If the circuit were connected directly or through spark gaps to such little earths, these dangerous surgings might be broken up and the line safely discharged without a possibility of the dynamo current following. Each spark gap in each of such discharge circuits would then form a discriminating lightning arrester, but these little earths would be nothing more or less than one coating of a condenser—the mother earth a common coating to them all. Why not then use condensers, connecting one side to line, the other to earth through a spark gap?

One difficulty immediately presented itself. After the condenser had become charged how was it to become discharged? To be successful it must be self-discharging, and not only this, but the discharge must take place in such a manner that no dynamo current should follow. Therefore, to discharge the condenser disruptively was at once out of the question. Experiments in this line led first to the application of a wet string to the terminals of a condenser, the idea being to leak out the charge through an ohmic resistance sufficiently great to prevent an appreciable flow of dynamo current. A two microfarad condenser provided with a wet string leak was treated with violent disruptive discharges from a battery of Leyden jars, and upon immediately applying the tongs to the terminals of the condenser after the crack of the discharge, not the smallest trace of a charge could be detected. When the string was removed or had become dry the charge was retained. Evidently a wet string would not answer as a permanent leak. Various compositions of plumbago with moulding sand, red lead and plaster-of-paris were pressed into a tube and used, but these all proved unsatisfactory, being unreliable. In many instances this composition leak would, before testing with the condenser, have a resistance of 30,000 ohms, and after a single discharge it would be found that this resistance had increased to many hundred thousand ohms. This was, perhaps, due to the flying apart of the plumbago particles under the influence of the discharge, and so breaking the continuity. Finally, a pencil mark over ground glass was suggested and this was found to work admirably. A medium pencil was rubbed back and forth over a strip of ground glass, making a narrow shining streak having a resistance of from 40,000 to 50,000 ohms. Rubbing with the hands did not seem to appreciably change this resistance. Broad black pencil marks were made on the ends for better contact, and connection to the terminals of the condenser was obtained through aluminium foil, both glass and foil being protected on the bottom by the wooden case of the condenser, and on top by a small inverted wooden trough. A condenser provided with such a pencil mark leak, was now connected to a 500 volt direct current circuit and to apparatus, as shown in Fig. 18. A was a 500 volt direct current generator; L one leg of the circuit, which may represent a trolley wire; G the other leg of the circuit, and which may represent the ground return; K the two microfarad condenser with its high resistance leak l; C a small spark gap in series with the condenser, and in the discharge circuit; B was a 12-32 inch spark gap over which disruptive discharges would pass from the battery of Leyden jars (11), and in this manner suddenly charge the line L. The most violent disruptive discharges that could be obtained in the laboratory were unable to damage either the generator or the condenser. A small spark gap, a trifle larger than C, connected either in series or in shunt to the generator, failed to take any of the discharges, thus demonstrating the ease with which the discharges were received by the condenser. Such tests were continued for half an hour at a time, the discharges following each other in



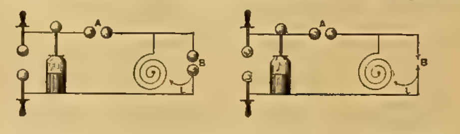
FIGS. 12, 13, 14, 15 AND 16. DISCRIMINATING LIGHTNING ARRESTERS.

rapid succession, but the condenser was ever ready, being kept constantly discharged by the high resistance leak. Of course, the resistance of the leak was sufficient to prevent the formation of an arc at C. The terminals of the leak were also too far apart to permit the condenser to discharge disruptively. This device insures all the requirements of a discriminating lightning arrester, and in this form seemed admirably adapted for station and indoor use on 500 volt direct current circuits.

For line or outdoor use the condenser was placed in a suitable cast-iron box, one terminal of the condenser being grounded to it while the other was led out through a specially designed and water-tight bushing. If then this iron box were buried in damp earth, as a ground plate, so to speak, the outer terminal connected to the lower electrode of a small spark gap placed on a pole, and the upper electrode of the gap connected to the line, the combination would constitute a discriminating line lightning arrester, Fig. 19.

Practical tests have been made during the past summer with both station and line condenser lightning arresters, and the results obtained have been most gratifying. The plant in which the apparatus was installed was that of the Denver Tramway company, Denver, Colo., in a locality where lightning storms are particularly severe and of frequent occurrence. This plant extends over a vast amount of territory and no attempt was made to protect it as a whole with these arresters. The experiences of this company with automatic lightning arresters on the line had been extremely unsatisfactory, and as a final measure they had resorted to simple carbon gaps liberally distributed over the system, depending upon the station circuit-breakers to interrupt the short-circuits. This combination, however, worked satisfactorily near the station only; at any considerable distance therefrom the drop on the line was such that even a short-circuit across these spark gaps failed to trip the breakers. The arc therefore continued until it had burned itself out, which in many cases was not accomplished until the top of its wooden pole had been burned off.

The installation of these condenser lightning arresters consisted of five arresters on the line and 44 spark gaps with 11 condensers in the station. The station spark gaps were also provided with two specially constructed choke coils for each feeder. The original arrangement of this apparatus is shown in Fig. 20. A is the generator; $F F$, etc., the feeders; 1, 2, 3, 4, etc., the 44 spark gaps alluded to; C^1 C^2, the two choke coils in series with each feeder; S represents the circuit-breakers and K keystone



FIGS. 9 AND 11. DISCRIMINATING LIGHTNING ARRESTERS.

lightning arresters; C is a bank of four two microfarad condensers, making a common ground for the 44 spark gaps; T is a tank lightning arrester; G is an overhead ground return; 5 a spark gap in the ground wire of the 44 spark gaps. A telltale piece of tissue paper was placed in this gap, which, becoming punctured, would at once indicate and register the passage of a discharge across any of the 44 spark gaps.

The first thunder storm which occurred after this apparatus had been installed gave unlooked for results. The telltale paper at 5 failed to indicate any discharge whatever—the spark gaps 1, 2, 3 and 4, which were placed in the cupola, were examined and many of these found to be badly burned. At first thought this indicated some path to earth other than that provided through gap 5 to the condensers. Tests for a ground, however, failed to prove this to be the case. A succeeding storm reproduced these same strange results. A more careful study of the problem now disclosed the fact that, as the circuit breakers were frequently thrown open during thunder storms, the feeders which were thus opened became ground wires, being grounded through their respective motors. Consequently, live feeders discharged

1. "Transactions, vol. ix., p. 102, 1892.

into these dead or grounded feeders, and vice versa, forming arcs which burned the carbon electrodes of the several spark gaps according to the amount of current taken by the respective feeders.

Fresh carbon electrodes were subsequently provided, and a single condenser connected to each group of spark gaps on the individual feeders, which arrangement would prevent the possible recurrence of arcing between feeders.

The line arresters had, however, in the meantime been carefully watched, and, after every storm, the telltale papers were collected and found to be perforated with a greater or less number of small holes, each hole being slightly discolored around the edges.

The sensitiveness of these condenser arresters was particularly noticeable, in that the telltale papers were found

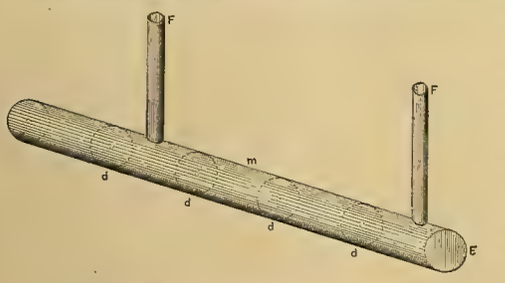


FIG. 17. DISCRIMINATING LIGHTNING ARRESTERS.

to be punctured at the slightest provocation, when, in fact, no considerable thunder storm had passed over the lines; and yet, sensitive as they were to slight charges on the line, it is remarkable to note that the simple carbon spark gaps belonging to the local company, which have already been mentioned, and which provided a gap one-eighth inch between electrodes, frequently received discharges in preference to the minute spark gap of a neighboring condenser line arrester. Such occurrences, coupled with many others of a similar nature, point to the existence of nodal points, and the necessity of distributing line arresters at frequent intervals over the system.

In fact, a lightning arrester connected directly to the terminals of a generator or motor offers no absolute guaranty of protection to this particular piece of apparatus. The presence of the arrester simply offers an opportunity for discharge. The discharge may occur in the armature or it may occur through the arrester, according to the particular conditions existing at the time of each discharge. The arrester could have a comparatively large spark gap and the breaking down strain of the armature insulation be low, and still the discharge might prefer the large gap to the weaker insulation, while, on the other hand, the arrester could have a very small spark gap and the armature be provided with the highest grade of insulation, yet in some cases this insulation would be pierced by the discharge in preference to the small spark gap of the neighboring arrester. A striking example of this possibility is illustrated in Fig. 21. *A* is a type of strain-wire insulator which is ordinarily capable of withstanding from 15,000 to 20,000 volts. *B* shows a wire connecting an overhead return to the ground wire return. The distance between wire *B* and the iron hoop holding the strain wire is about one inch. During a violent thunder storm the insulator *A* was punctured by a discharge which passed from the trolley wire through the insulator to the iron hoop and thence across the one-inch air space to the grounded wire *B*, and this very high ohmic resistance path was taken in preference to a neighboring line arrester having a small spark gap. Had an arrester been connected at this point there is no question but that the arrester would have taken the discharge, but by reason of the nodal points which are formed along the line by the electric surgings, a lightning arrester 100 yards away, although it is liable to take a large proportion of the discharges, does not by any means offer an absolute guar-

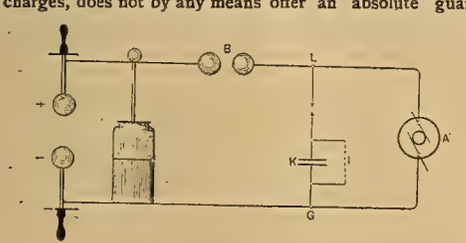


FIG. 18. DISCRIMINATING LIGHTNING ARRESTERS.

antee of protection to a neighboring piece of apparatus. A large number of line arresters, that is, a large number of opportunities for discharge, is the surest means of securing efficient protection.

The results obtained with these condenser arresters have exceeded my expectations, and in my opinion have thrown considerable light on the intensity and volume of discharges commonly found in electric light and power circuits. During my two months' stay in Denver not a single condenser was disabled, nor were any of the telltale papers burned. I have with me a few of these perforated papers which I shall be glad to have you inspect. I was not present in Denver after the burned-out spark gaps in the station had been replaced, and am therefore not in possession of any further data from that source. But in Colorado Springs, where I spent the next following six weeks, I connected three of these condenser arresters in the station of the Colorado Springs Rapid Transit Railway company and was treated to many violent thunder storms, through all of which these arresters showed a wonderful capacity for repeatedly and rapidly discharging the line. Through many of these storms the discharges passed the spark gaps as many as twenty times a minute, completely riddling the tell-tale papers.

I may, therefore, say with emphasis, that the condenser lightning arrester has proved itself most efficient in points of sensitiveness, durability and general reliability. In actual service it has demonstrated the successful construction of a truly discriminating direct current lightning arrester.

The Trolley Appreciated in Brooklyn.

[From the *New York Tribune.*]

The trolley has now been in use in Brooklyn for a year and is gradually taking possession of the entire field of transportation on the surface of the streets. The Eastern District has not yet been extensively invaded, although several trolley lines now run there; but in a short time on all the lines in that part of the city horses will be used no more. There is one cable line in the city, but it is not of large importance; it runs in Montague street, from Court street to the Wall street Ferry. It saves a good many people, however, from the climb up the Montague street hill, which, while not exceedingly steep, slopes up at a peculiar angle which makes walking there a weariness to the flesh, especially on hot summer afternoons.

It is fair to say that public opinion in Brooklyn in reference to the trolley has undergone a considerable change in the course of the last year. When the use of the trolley was threatened on a large scale many people regarded the prospect with genuine alarm. They had heard of it, if they had not seen it in operation in other cities, and knew

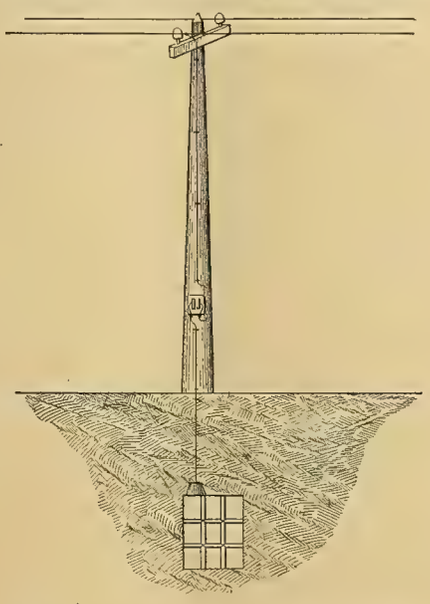


FIG. 19. DISCRIMINATING LIGHTNING ARRESTERS.

that trolley cars were often run at high speed, and were a source of great danger to people in the streets. They didn't like the prospect of having their streets lined with poles supporting miles of wire carrying powerful currents of electricity. They had heard of the buzz of the trolley on the wire, and of the "trolley jerk" which the inexperienced motorman knows how to perpetrate with disastrous effects on passengers standing inside a car.

The general attitude of Brooklynites was adverse to the trolley, and for a number of months after the electric cars were put in use experience showed that the apprehensions which had been aroused were far from baseless. Accidents followed each other with alarming rapidity. The trolley cars ran at least twice as fast as the horse cars had done, and people had to be educated up to the point of looking out for them. This was especially the case with children, who formed a large proportion of the victims in the first six months of the general use of the new motive power.

It was by no means the children alone who needed to be educated. The motormen did not understand their business thoroughly; frequently they ran too fast, and they failed to keep a sufficiently sharp watch upon the tracks ahead of them. Several lives were lost because passengers alighted from a car and passed around in the rear of it to cross the other track, without observing that a car was coming down rapidly on that track. Then people took needless risks. A policeman was killed by attempting to board the front platform of a car in broad daylight and not long afterward a druggist in upper Fulton street met his death in precisely the same manner, although this casualty occurred about midnight.

Gradually, however, the people have accustomed themselves to the new traction agent, and its good points have become recognized. The increase in speed is an important consideration, and, except in the more crowded parts of the city, it is felt that a speed of ten miles an hour is not unsafe. This feeling manifested itself with considerable emphasis when a bill was laid before the Legislature a few weeks ago requiring the trolley cars to run no faster than six miles an hour. Undoubtedly the bill originated with the elevated roads, which had suffered a considerable loss of business by reason of the competition of the trolley, and no one appeared to advocate it except the counsel of one of the elevated companies. The opposition to it was so strong, however, that it never emerged from the committee-room.

Since about the beginning of the year there has been a marked diminution in the number of trolley car accidents, although within the last fortnight two or three persons have been killed. In one of these cases at least the motorman appears to have been running his car far beyond the legal speed.

No one contends that the trolley is perfect. But it seems to have come to stay. Its cheapness is a strong recommendation to the surface companies, and, of course, if it should be found practicable to run the trolley wires underground, the cars would still run as fast as they do now and the factor of danger to pedestrians would not be eliminated. It is believed by a considerable number of people

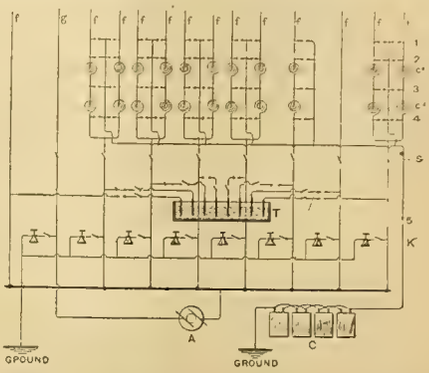


FIG. 20. DISCRIMINATING LIGHTNING ARRESTERS.

that safety in the operation of these cars would be increased by the use of a jingling bell, which would ring continually while a car is in motion. Of course there is an objection to this in Fulton street, for example, where a large number of cars are constantly moving, and where the ringing of numerous bells would add to the noise and produce confusion in some minds. But away from the centers of business it is believed that bells of this sort would afford a needed warning in many cases. There is a singing of the wire as the car approaches or recedes, it is true, but this is unsatisfactory and untrustworthy as a signal.

Such a bell would probably have prevented the accidents occurring when persons passing behind a car in order to cross to the farther side of the street have been run down by the car coming, unseen and comparatively silent, on the other track. It would tend to the safety of all people walking, and a bicycle rider says that it would be of great advantage to men of his class, who frequently have difficulty, when approaching car tracks, in telling whether the way is clear. Of course every rider slows up and proceeds cautiously when coming to a street on which trolley cars run, but if the eye could be assisted by the ear it would be decidedly to his advantage.

It is a question whether anything is gained by placing a gate on the side of the car platform next the other track. It seems reasonable that if a man could get a clear view forward as he was about to alight on that side he would not step off if a car were approaching in the opposite direction. Some accidents, therefore, might be prevented by removing the gate, which is required by the state railroad commission.

On a few of the lines in Brooklyn there is a requirement on open cars of a chain or barrier of some kind on the side nearest the other track, and on the lines soon to be equipped with the trolley by the City Railroad company, a stipulation has been made that such guards must be provided on all open cars. And yet it is an interesting fact that

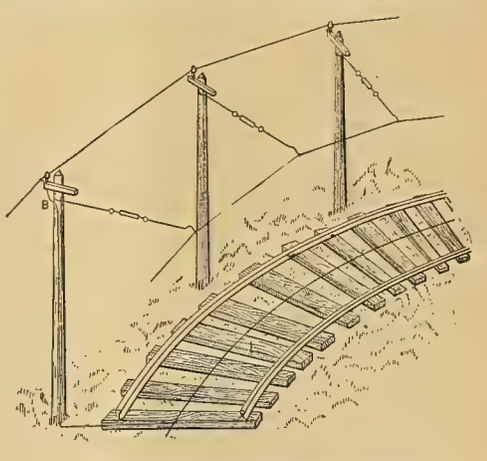


FIG. 21. DISCRIMINATING LIGHTNING ARRESTERS.

few, if any, accidents have occurred from passengers alighting from open cars on what is supposed to be the dangerous side. The reason appears to be that they can look out and see whether danger is approaching in the shape of another car.

There is a decided difference in the smoothness with which the trolley cars run on the various lines. This is said to be due largely, if not wholly, to the manner in which the tracks are laid. In most cases this work has been done by the companies themselves. On the lines of the Broadway system (now under control of the City company), which are about to be equipped with the trolley, the writer is informed, however, that the new tracks are to be put down by a firm of contractors which has done work of this sort in other cities with great success, and which guarantees a more smooth and even track than any now in Brooklyn.

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MUCH interest will attach to the experiments now being conducted at Newport, where the annual season of instruction to naval officers in the care and handling of torpedoes was begun on Monday. The special feature of the meeting will be the new course, introduced under the direction of Lieutenant Fletcher, of running torpedo boats and eluding searchlights. The Cushing and the Stiletto have been selected for this service, and comparative tests will be made, elaborate preparations having been made for the experiments. The Cushing has been painted a greenish black, but the Stiletto remains an olive green, the color that was thought to be the least observable in the searchlight as a result of last season's experiments. The class will be taken down to Peconic Bay twice a week, and on returning will endeavor to escape the searchlight of the torpedo station. Lieutenant Fletcher, it is said, believes that by getting the boat directly into the beam of the light and with all hands out of sight, it may be run into the beam under full speed, and when the light is shifted from the craft to lay to quietly until it returns. This theory will be fairly tested and the result will be awaited with interest.

AN interesting and important decision by the United States Supreme Court on the liability of a telegraph company for errors in transmitting messages in cipher was handed down last week. The case had been in litigation for several years and involved a claim for damages amounting to $100,000, and the question of the right of the company to impose the conditions named in the contract on the telegraph company's blanks These conditions absolved the company from liability for errors when the message was written in cipher, and the circuit court judge decided that this contract was reasonable and valid. This decision, from which the plaintiff appealed, has now been affirmed by the Supreme Court, and is certainly an important victory for the telegraph company.

THE first installment of Mr. Wurts' Institute paper on "Discriminating Lightning Arresters, and Recent Progress in Means for Protection against Lightning," is presented in this issue. It is a plain statement of the experiments which Mr. Wurts has been conducting during the last few years, and the conclusions formed from studying the results obtained. An idea of the thorough manner in which these experiments were conducted is conveyed in the statement that after devoting several months to investigation of this subject, experimenting with disruptive discharges and various kinds and combinations of apparatus which might promise advantageous results, Mr. Wurts spent nearly six months in Colorado in testing forms of apparatus which he had designed as a possible protection against lightning, and studying such phenomena as presented themselves. That this work was carefully and intelligently done is evident from the comprehensive report which was laid before the Institute. It is a valuable contribution to the literature of the subject and will no doubt attract considerable attention. It should be carefully considered by every one engaged in the transmission of electricity, whether for light, heat or power.

PROF. ANTHONY'S paper at the Philadelphia meeting of the Institute, which is presented elsewhere in this issue, awakened considerable interest, and there was a spirited discussion over his statements regarding the actual illuminating power of a "2 000 candle power" arc lamp. Prof. Anthony said that there was no 450 watt arc lamp in use that would measure 2,000 candle power in the direction of greatest intensity. Compared with other sources of artificial illumination and measured as other sources are measured, he said, no 450 watt arc lamp when surrounded by a glass globe would give more than 500 candle power. Of course this statement was vigorously denied, yet Prof. Anthony persisted in maintaining the correctness of his position, and in this he was sustained by several authorities. It is not to be expected, and, in fact, it is not to be desired, that the discussion will close here. There is no doubt that much harm has come from the practice of overrating the illuminating power of arc lamps, and it is to be hoped that manufacturers of lighting apparatus and all others interested will co-operate in the movement to have arc lamps properly rated.

WHERE shall the oponents of the overhead trolley system turn for comfort now? Brooklyn was their mainstay and chief support—their "terrible example" *par excellence* —and that city was pointed to with a shudder of holy horror whenever it was proposed to supersede the horse cars of any large city by the electrical method of propulsion with overhead wires. But Brooklyn, after a year's trial of the trolley, is satisfied that a great improvement has been made in its street railroad facilities, and the system is being widely extended. Of course this result was confidently apprehended by those who are familiar with the development of the street railway industry in this country during the last dozen years, but it is none the less gratifying to witness a leading metropolitan newspaper like the *New York Tribune* giving testimony to the fact, as is done in a well considered article reprinted on another page. The overhead trolley system is not perfect, and doubtless improvements can be made in the service in Brooklyn as elsewhere, but it is a very decided advance over animal power and at the present day the best method of furnishing rapid transit in cities on surface lines. This fact will be demonstrated in Chicago, as it has been in Boston, Brooklyn and other large cities, and this despite the opposition of a purblind and prejudiced daily press.

IN connection with the convention of the American Street Railway association at Atlanta, Ga., on October 17th, there will be an exhibition of street railway apparatus and supplies, such as has never been seen in the South. The great Machinery Hall of the Piedmont Exposition company has been secured, and power will be furnished so that exhibitors can show their machinery in operation, which, of course, is much more satisfactory than to display apparatus lying idle. The convention proper will attract managers of street railway companies from every part of the country, and there is no doubt that a very satisfactory and successful meeting will be held. As usual, practical papers by experienced men will be read and discussed. During the last few years the importance of these meetings has grown, until to-day, the association is considered one of the most powerful organizations of the kind in the country. It has been noted, too, that these meetings have of late years taken on the character of electrical gatherings, largely, and they afford the best possible evidence of the popularity of the electric railway throughout the country. Of course electrical manufacturers realize the importance of these gatherings and it is to their interest to contribute to the success of the meetings. They afford manufacturers the best possible opportunity to show improvements in their equipment and any new specialties which they may be introducing. They also give the managers of street railway companies an opportunity to compare the several systems and study the characteristics of each. This year's convention promises unusual advantages. The exhibition will extend over two weeks, and members who attend the meetings of the association will have ample opportunity to examine the exhibits at their leisure after the close of the convention proper. There is every reason to anticipate a successful meeting, and it is to be hoped that the expectations of the managers of the exhibition will be fully realized.

THE approval of the Chamber of Commerce rapid transit bill by Governor Flower completes what was in some respects the most important legislative act of the recent session of the New York Legislature. The bill is not in all respects the most effective that might have been framed, but it opens a practical way of reaching real rapid transit, and provides a commission that ought to be able to pursue that way. The rapid transit problem is the most important question of the day in many large cities of the country, and many of these are fast arriving at the conclusion which New York has just reached in the passage of this act.

In discussing the preferred methods of rapid transit for Pittsburg, the *Dispatch* of that city notes that "the greatest city in the world, and the one where there has been actual experience with underground railways, bears the most convincing testimony to the success of that method of transit in great crowded systems by adopting it for further lines. The latest project is one for giving passengers arriving at Waterloo station quick transit to the Mansion House in the city. It will be built under the guaranty of the London & Southwestern Railway company, and will be a mile and a half long, at an average depth of 60 feet below the street level, and passing under the Thames about 20 feet below the river bottom. Electricity will be the motive power, as in the City & South London, which has been in operation for about three years with thorough success. * * * Of the greater merit of the underground plan when adopted there can scarcely be any doubt. There is no disfigurement of the city, as in the case of the elevated roads; no blocking of the view from windows, and no darkening of the streets. The elevated structure must deteriorate some time, while the underground tunnel should last as long as the rocks, and the hazards of derailment are much less in the latter." It is indeed pleasing to note the growing popularity of the underground road, and there are unquestionably instances where no other system should be adopted, but in contemplating the one it must not be forgotten that, by the substitution of electricity for steam, many of the unpleasant features of our elevated roads are eliminated. Although it is to be hoped that New York may now obtain an underground road for which electricity shall be the motive power, Chicago will be content to stand as the exponent of electric elevated road practice in this country for the present at least. Much has been accomplished in the interest of rapid transit in both cities since the first of the year, and each city can afford to congratulate the other upon its advancement.

American Street Railway Association.

In connection with the thirteenth annual meeting of the American Street Railway association at Atlanta, Ga., on October 17th, there will be an exposition of street railway machinery, supplies and apparatus of every kind. This exhibition will be held in machinery hall of the Piedmont Exposition company, which has been secured for two full weeks, beginning October 10th and lasting until October 24th. The accompanying diagram will give an idea of the arrangement of the hall in which the exhibition will be held. The convention hall is in the same building—an admirable feature, by the way.

N. W. L. Brown, chairman of the committee on exhibits, has issued a circular containing directions and rules for exhibitors. In this it is announced that space will be allotted on June 15th to all exhibitors whose applications have been filed with the secretary and accepted on or before that date, and that applications received and accepted after June 15th will be allotted remaining space, if any, in the order of their acceptance.

The space will be charged for at the rate of fifteen cents a square foot, and no space less than 100 square feet will be rented, nor more than 2,000 square feet, unless by special arrangement with the secretary.

Space allotted cannot be transferred without permission, and must be taken possession of on or before October 16th. Articles placed on exhibition cannot be removed without the written permission of the secrerary. All goods shipped to the exhibition should be plainly marked "Street Railway Exposition, Atlanta, Ga." It is advisable to secure a time limit delivery and to allow plenty of time for transportation.

On and after October 10th exhibitors and their agents and workmen will be admitted to the building for the purpose of preparing necessary structures. The general reception of articles for exhibition will commence on October 10th. All goods intended for exhibition must be on the premises and properly displayed on or before Tuesday evening, October 16th.

Exhibitors of machinery in operation must have everything in running order, in readiness to start their machinery on the morning of the opening day. Exhibitors must provide all countershafts, pulleys, belting, switches, switchboards, etc., necessary for the operation of their machinery.

Electric power will be furnished to those who use power. The charge therefor during the entire time of the exposition will be 45 cents per rated kilowatt of machine actually using current. The minimum charge for power will be fifteen dollars. All machinery will, if possible, be exhibited in motion, and should be kept in motion at regular work during the hours 9 to 12 A. M., 2 to 6 and 7 to closing P. M.

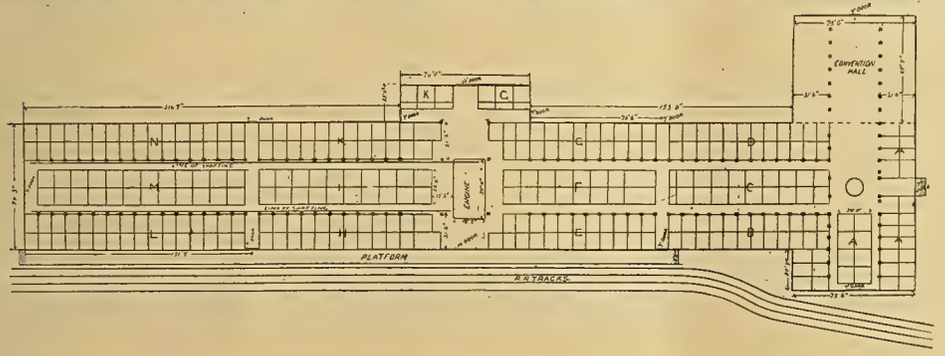
No platform or other structure must be nailed to the floors or walls. Exhibitors must not place any sign or circulate advertisements, except such as pertain to their own business (and those only in their own space), without written permission from the secretary.

Exhibitors desiring to sell and deliver in the building any articles whatever must first obtain a written permit from the secretary, for such consideration as may be determined upon.

Any permit to sell may be revoked at any time at the pleasure of the association.

Every possible precaution will be taken to guard against fire, and a full corps of watchmen will be on duty day and night; but the association will not be responsible for loss or damage to articles on exhibition by theft, fire or otherwise.

The association reserves the right to charge an admission fee to the citizens of Atlanta should it so determine, but the admission of exhibitors and their agents will be free.



AMERICAN STREET RAILWAY ASSOCIATION.—FLOOR PLAN OF EXPOSITION HALL.

An electric club has been organized in Richmond, Va.

On the Subdivision and Distribution of Artificial Sources of Illumination.[1]

By Prof. William A. Anthony.

It is a well recognized principle that to illuminate evenly a given area by means of an artificial source, it is necessary that this source should consist of numerous small sources distributed over the area. In carrying out this principle it is usual to divide the area to be lighted into squares, and place a lamp in the center of each square, as shown in Fig. 1, where each lamp is represented by the sign +. In order to study the distribution of light by this arrangement of lamps, I have computed the illumination at the central point of the figure due to the lamps situated upon the boundaries of each of the squares represented by the dotted lines, the illumination produced by the lamps on the smallest square to be taken as unity. The following table gives the values up to the twelfth square, twice the number represented in Fig. 1, and corresponding, therefore, to an installation in which four times as many lamps are used:

I.	II.	III.	IV.	V.
1	1.000	1.000	4	4
2	.511	1.511	12	16
3	.312	1.823	20	36
4	.223	2.046	28	64
5	.174	2.220	36	100
6	.143	2.363	44	144
7	.121	2.484	52	196
8	.104	2.588	60	256
9	.092	2.680	68	324
10	.083	2.763	76	400
11	.075	2.838	84	484
12	.067	2.905	92	576

Column I. gives the designating number of each square counting outward from the central point. Column II. gives the illumination at the center due to the lamps located on each boundary. Column III. gives the total illumination at the center due to the lamps included within and upon each boundary. Column IV. gives the number of lamps situated upon each boundary. Column V. gives the total number of lamps.

It is seen from the table that the twelfth series which consists of 92 lamps gives at the center less than 7 per cent. as much light as the first series of four lamps, and contributes only about two and one-half per cent. to the total illumination at the center. This arrangement of the lamps does not give an even distribution of light over the entire area, as will be evident from a consideration of the illumination upon the outside boundaries of the space. It is evident that the point *B* at the corner of Fig. 1 receives one-fourth as much light as it would if it were the center of an area four times as large, and lighted by four times as many, or 576 lights. But the illumination at the center of such an area, as seen by the table, is 2.905. The illumination at *B* is, therefore, 2.905÷4, or .726, while the illumination at *A* from the sixth line of the table is 2.363. The illumination at *B* is then less than one-third that at *A*. At *C* the illumination is evidently but little more than half that at *A*. Points located between the center and outside would be illuminated to an intermediate degree, but after leaving the outer boundary the illumination would rapidly approach that at the center of the figure. I am considering always points of least illumination in any region, that is, points situated as far as possible from any lamp. It is evident, therefore, that to obtain a uniform distribution of light, the lamps must be concentrated toward the outer boundary of the space instead of being placed at equal distances throughout, as in the figure.

But the most interesting question connected with this matter is, What is the effect upon the uniformity of the illumination of grouping the lamps in clusters or using larger lamps at fewer points? It is evident that whatever the candle power of the lamps or their distances apart in a distribution like that represented in Fig. 1, the relations represented in the table will remain unchanged. It is evident also that the illumination at the central point will be proportional to the intensity of the individual sources (if lamps are placed in clusters, each cluster is to be considered as a source) and inversely to the square of the distance between the sources.

This illumination is, therefore, given by the formula

$$K\frac{S}{d^2}C$$

where K is a constant depending on the units employed, S the intensity of the individual sources, d the common distance between them, and C the quantity in column III. of the table corresponding to the number of sources as found in column V.

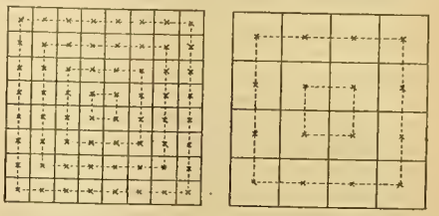
1. Read at the eleventh general meeting of the American Institute of Electrical Engineers, Philadelphia, May 15, 1894.

Compare the illumination at the center of an area lighted by 576 lamps with that at the center of the same area lighted by the same lamps arranged in 144 clusters of four lamps each. If s and d represent the intensity and distance in the first case, 4s and 2d will represent the corresponding quantities in the second case. C in the first case is 2.905, corresponding to 576 sources. In the second case, for 144 sources C is 2.363. The relation sought is, therefore,

$$K\frac{4s}{4d^2}2.363 \qquad \frac{s}{d^2}=.813$$

$$K\frac{s}{d^2}2.905$$

The light at the central point, with the fewer sources, is only 81 per cent. of that obtained under the first arrangement. Other points of minimum illumination will suffer in like manner.



FIGS. 2 AND 3. SUBDIVISION AND DISTRIBUTION OF ARTIFICIAL SOURCES OF ILLUMINATION.

On the other hand, points near the clusters of lamps will be much more strongly illuminated than corresponding points near the single lamps of the first arrangement.

If it be required that the illumination at no point shall be less in the second case than in the first, it will be necessary to increase the intensity of the sources nearly 25 per cent., or make the clusters consist of five instead of four lamps.

Again, suppose an area lighted by sixty-four 16 candle power lamps distributed as in Fig. 2. It is required to substitute sixteen lamps of larger candle power distributed as in Fig. 3, and fulfilling the condition that the minimum illumination shall be no less in the latter case. If x be the candle power of the larger lamps, we have:

$$\frac{x}{4d^2}\times 1.511=\frac{16}{d^2}\times 2.046$$

$$x=64\times\frac{2.046}{1.511}=86.7$$

From which it appears that the total candle power must be increased 35½ per cent. If the 16 candle power lamps consumed 3.5 watts per candle power, the larger lamps to compete with them should consume less than 2.6 watts per candle.

It will be noted from the two examples given that the loss from reducing the number of sources in a given ratio is less when the number is large. In other words, large lamps, or clusters of lamps, can be more economically used for large than for small areas.

An inspection of the table will show that, while a given area may be lighted satisfactorily by sixteen clusters of four lamps each, an area one fourth as large, lighted by four clusters at the same distance apart, would not be as well lighted with six lamps to the cluster. It will be seen, also, that the larger the area the further apart may lamps of the same candle power be placed. For example, a room forty feet square with sixteen lamps ten feet apart is fully

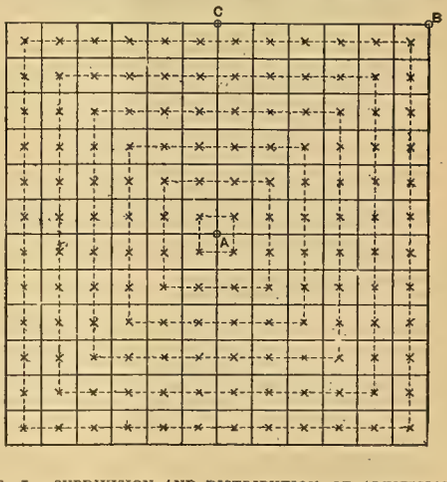


FIG. 1. SUBDIVISION AND DISTRIBUTION OF ARTIFICIAL SOURCES OF ILLUMINATION.

as well lighted as a room sixteen feet square with four lamps eight feet apart.

Let us compare arc and incandescent lights on the same basis, that the minimum illumination shall be the same under both systems. First, I must say that the efficiency of arc lights has been greatly overrated. Instead of being ten times, it is rarely three times, and often only one and a half times that of an incandescent lamp.[1] This is for the naked arc. For indoor illumination ground or opal globes are nearly always used, and these cut off fully half

1. See "Efficiency of Artificial Methods of Illumination." Dr. Nichols: Transactions, vol. vi., p. 171.

2. "Loss of Light from Use of Globes with Arc Lamps." George D. Shepardson: *Electrical World*, vol. xxiii., p. 287.

the light. This leaves the efficiency at the most 1.5 times that of the incandescent lamp. The power required for a 16 candle incandescent lamp is 50 watts, and for a full arc lamp 450 watts. The arc lamp must, therefore, replace nine incandescents. Assuming that the lamps are distributed as described in this paper, the table shows that if four arcs take the place of 36 incandescents, their efficiency as compared with the incandescents must be 1.823, and with a relative efficiency of only 1.5, the arc lamps would not light the space as well as the incandescents. If 16 arcs take the place of 144 incandescents, the ratio of the efficiencies required is 1.56, and arcs at 1.5 are still not equal to the incandescents. If 64 arcs take the place of 576 incandescents, the ratio of the efficiencies becomes 1.42, and arcs at 1.5 would be an improvement on the incandescents. It comes then to this, that unless the area to be lighted is so large as to require about 500 incandescent lamps distributed uniformly over it, the use of full arc lamps requiring the same power will leave some parts of the area less brilliantly lighted.

If we could make small arc lamps of the same efficiency as the full arc—by full arc I mean the so-called 2,000 candle lamp consuming about 450 watts—we could improve somewhat upon the result as obtained above. But the fact that the mechanism of a small arc lamp costs just as much as that of a large one, and that each small arc will require as much care and attention as a large one, would place a limit upon the subdivision of the arc even if the efficiency could be maintained. And here I wish to enter a protest against the assumption that I often find in discussions of this subject, that the so-called 1,200 and 2,000 candle power arc lamps are 1,200 and 2,000 candle lamps. There is no 450 watt arc lamp in use that will measure 2,000 candles in the direction of greatest intensity, and compared with other artificial sources for general illumination, that is, measured as other sources are measured, there is no 450 watt lamp that will give, when surrounded by a plain glass globe, 500 candles.

In a linear distribution, as in street lighting, the arc is at a still greater disadvantage. Remembering that nine 16 candle incandescent lamps can be run with the power required for one 450 watt arc, it is seen that the arcs must be nine times as far apart as incandescents consuming the same power, and to give the same minimum illumination must be 81 times as intense or about 1,300 candle power. But in no arc lamp as used for street lighting do the rays proceeding toward the most distant points to be illuminated reach more than one-fourth this intensity. In my way of thinking, the location of arc lamps at intervals of 1,000 to 1,600 feet, as they are often seen in pretentious country villages and suburban places, is an entire waste of money. A little spot 50 to 100 feet in diameter under each lamp is brilliantly lighted, while the more distant points are in darkness all the more profound from the loss of sensitiveness of the eye when in the strong light. Incandescant lamps at intervals of 100 to 200 feet, which could be run by the same power, would give a far better illumination.

Of course, in deciding between the use of arc and incandescent lamps in any special case, there are other questions to considered besides that of the power required to operate. Practical questions of installation may outweigh all others. The considerations of these is foreign to this paper. The question I have considered is purely one of efficiency, and in treating that question I have assumed that every part of a space to be lighted needs the same amount of light. I have omitted from the consideration all effects of reflection from ceilings, walls or reflectors purposely provided, as those are too various and depend too much upon the conditions in each special case to be introduced into a general discussion. My main object has been to point out to just what extent the general illumination of a space is affected, other things being equal, by the use of large in the place of small sources, using in the aggregate the same power, and I trust the figures and illustrations I have given may be found useful in considering the special cases that may arise.

Mineral Production of the United States in 1892 and 1893.

The immensity and variety of the mineral production of the United States are emphasized by the data recently collected, showing the output and the value of the chief mineral products in 1892 and 1893. These statistics have been compiled for Vol. II. of "The Mineral Industry: Its Statistics, Technology and Trade," the statistical supplement of the *Engineering and Mining Journal*. It appears that in the year 1893 the mineral and metal production of this country as compared with 1892 has not declined in quantity as much as might have been expected from the financial depression, but it does show a material decline in values, amounting to over $79,000,000. It is a noteworthy fact that the mineral production alone, while almost one-third greater in value than the metal product, decreased only one-half as much. Of the total decrease, over $30,000,000 was in the decreased production and shrinkage of values in pig iron; $9,000,000 was in coke and $6,000,000 in bituminous coal, both of which were largely due to the decline in pig iron production. In silver the decrease in value amounted to $6,000,000. In but few cases were there any increase. Anthracite coal gained $4,000,000 in value, thus partly offsetting the decline in bituminous, and gold increased $3,000,000. The figures clearly show the solid foundation upon which the country's prosperity is based, and its stability. Knowledge of technical and industrial practice has advanced in all civilized countries, but the practice has not always followed the knowledge. In the United States the rapidity with which one improvement has followed another has given our engineers a special training not obtainable elsewhere, so that instead of the United States sending to Europe for experts to advise on processes or direct the operation of industries, the older countries call upon our engineers to go to every part of the world where a mineral industry exists.

When Telegraph Companies are Not Liable for Errors.

The Supreme Court of the United States on May 26th decided that the Western Union Telegraph company was not liable in damages to the sender of a message in cipher for errors in transmission thereof. The case was appealed from the Circuit Court of the United States for the Eastern District of Pennsylvania, where Frank J. Primrose sued the telegraph company for $100,000 damages for mistakes in sending a cipher telegram from Philadelphia to Waukeeny, Kan. The message related to a transaction in wool, and the mistake, Primrose claimed, damaged him in the sum named. Judge Butler non-suited the plaintiff in Circuit Court, on the ground that the conditions of the contract printed on the back of the telegram absolved the telegraph company from liability for errors by transmission, unless it especially insured correctness. This contract was held to be a reasonable one. Justice Gray, for the Supreme Court of the United States, affirmed the judgment of the Circuit Court. The case has been pending in the Supreme Court since 1879.

Sunday Telephone Work and the Church.

Telephone girls who may belong to the Presbyterian church will be interested in the action of the General Assembly of the Southern Presbyterian church, recently in session at Nashville, in the case of Sadie Means. It will be remembered that Miss Means, who is an exchange operator at Columbia, S. C., was disciplined by her church for working on Sunday. The lady's friends made a stout defense, and the case was taken to the presbytery and then to the synod. The decision of the latter body was in favor of Miss Means, and it was on appeal that the General Assembly considered the case. There was considerable debate, but the majority held that the use of the telephone on Sunday was a necessity, and by a vote of 48 to 15 the appeal from the decision of the synod was not sustained, thus establishing Miss Means' contention that she could not be debarred from church privileges on account of her Sunday labor in the telephone exchange.

Electric Work in Cleveland.

At a meeting of the Cleveland, O., Board of Control last month an ordinance was presented granting a private electric lighting company the right to lay conduits in certain downtown streets for the purpose of furnishing a number of business blocks with electric light. The ordinance stipulated that the company must give a bond in the amount of $20,000 to protect the city from any damage which may ensue. It was thought that it would be a dangerous precedent to grant the company permission to put its conduits in the streets, but upon the representation that the private company could furnish light cheaper than the existing company, and that the board had no right to prevent anyone from engaging in business, the ordinance was recommended to the council.

Electric Light Injunctions.

In the United States Circuit Court at Philadelphia, May 15th, the Edison Electric Light company was granted injunctions by Judge Dallas restraining the following defendants from using incandescent lamps containing infringments on the Edison patents: B. F. Keith and others, proprietors of the Bijou Theater, the Suburban Electric Light company, the *Press* company, Burnham, Williams & Co., Hoopes & Townsend, and the Columbia Electric company. The motion for an injunction against the city of Philadelphia, restraining the use of the same kind of lamps in the public buildings went over for a week.

Natural Gas Ignited by Lightning.

During a recent severe thunderstorm in Indiana lightning struck the large gas-regulator house at the location of the four gas wells owned by the Winchester Gas company, near Zelma, completely destroying it. The pipes were torn loose from one of the wells and the gas ignited. Soon the entire product of the four wells was ablaze. The blaze shot a hundred feet into the air. This with the roaring caused great excitement for miles around. The blaze could be seen easily from Muncie, a distance of seven miles.

Judge Buckles, of the Superior Court, has refused to confirm the recent sale of the Vallejo, Cal., Electric Light company's plant, which was bid in at sheriff's sale early in April by ex-Senator James McCudden, at his bid of $2,850. The judge holds that the sum bid was far below the value of the property.

The Coal Famine and Electric Plants.

Attention has already been called in this journal to the growing seriousness of the disturbances in the coal regions of the country and the consequent scarcity of coal which has been felt by electrical concerns. There is, unfortunately, no prospect of a speedy settlement of the difficulty. On the contrary, reports from electric lighting plants which are dependent upon coal as a fuel are very discouraging. In many places managers of plants have been obliged to burn wood, and in others it has been necessary to shut down entirely. The consequences of paralyzing such an industry as the electric lighting business are particularly deplorable, for to the losses of the companies must be added the inconveniences and the danger to which the community is exposed. Following are a few extracts from newspapers published in the vicinity of the troubles noted:

The electric light works at the Union coal shaft will have to stop for want of coal.—*News-Herald*, Peru, Ill.

Several electric light plants over the country are now burning part wood so as to economize their coal supply as it is not known where they can obtain more when what is now on hand is used up. At Bloomington the arc circuit on the street is not used at all. The engineer at the plant here has begun to economize and the lights are shut off an hour and a half earlier than the usual time. The coal supply is being rapidly diminished and if you are without light soon you will know the reason why.—*Tribune*, Oxford, Ind.

On account of the coal famine the city electric light plant at the pumping station will hereafter run up to midnight only instead of running all night as usual.—*Beacon*, Aurora, Ill.

Unless the miners' strike can be settled before ten days, Bloomington will have neither electric light nor water. The electric lights have already been shut off because of the scarcity of coal.—*Free Trader*, Ottawa, Ill.

Without coal the Delavan electric light works will have to close down next week.—*Pantagraph*, Bloomington, Ill.

The electric company has begun making steam from wood of late, being unable to get an adequate supply of coal.—*Chronicle*, DeKalb, Ill.

The electric light plant is threatened with a shut down, owning to the coal famine.—*Illinonian*, Wheaton, Ill.

The electric plant has shut down for want of coal.—*News*, Elgin, Ill.

The patrons of the Bement Electric Light company have been notified to get their coal oil lamps ready for use. The company is compelled to use cobs for fuel and when they are gone will be compelled to shut down.—*Review*, Decatur, Ill.

The electric light plant has temporarily arranged to burn wood, so that light is assured until "this cruel war is over."—*Free Press*, Carbondale, Ill.

The city was in darkness last night as far as electric lights are concerned. The coal famine has affected us and compelled the shutting down of that part of La Salle's enterprise.—*Journal*, La Salle, Ill.

The electric light plant at Danville is burning wood because of the inability to produce coal.—*Review*, Fairmont, Ill.

The electric light company, owing to the scarcity of coal, is burning cord wood and a little coal at its power house to keep up steam and the lights going. It is believed that it will now pull through without trouble. We notice that other manufacturing establishments are burning wood with their coal to help out. Several carloads of coal from Kentucky arrived here last evening for use here to help out during the strike and more is to follow.—*Journal*, Peoria, Ill.

The electric light has not been furnished until 11 P. M. as required, on account of scarcity of coal, occasioned by the miners' strike. It may be the plant will have to close down if the strike continues.—*Leader*, Fowler, Ind.

These examples of the trouble caused by the strike have been taken from Illinois and Indiana, and could be multiplied many times. But the following extracts will show that these two states are not by any means the only sufferers:

Owing to the shortage in the coal supply the street electric lights have been turned off, and will shine no more until the strike among the miners of soft coal is settled. The public works committee thinks this advisable rather than incur the expense of burning wood or hard coal. The incandescent lights, however, and the water supply will be continued at any cost.—*Standard*, Hillsdale, Mich.

The city electric lighting plant is not running at present on account of the shortage of coal. Using oil for fuel was tried, but proved a dismal failure, and now natural gas has been put in, but thus far has not given satisfaction, as the engineers are unable to produce sufficient quantities of steam to run the plant.—*News*, Jamestown, N. Y.

The miners' strike in Des Moines will close the electric light works and leave the city in darkness.—*Tribune*, Muscatine, Ia.

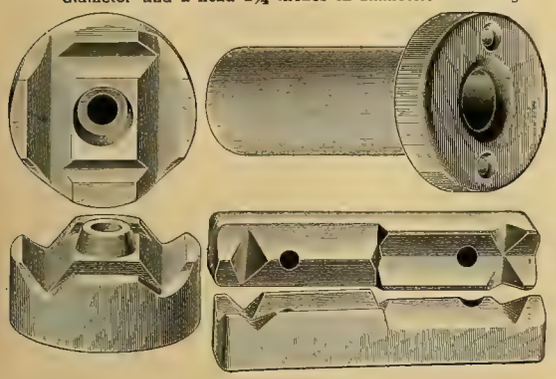
The Electric Light company has been running on short hours the past week, closing down at 10 o'clock in the evening. The supply of coal has been cut off on account of the coal mines strike; hence the shut down.—*Herald*, Carroll, Ia.

The electric plant in St. Joseph, Mo., has coal sufficient to last only a few days.—*Daily Inter Ocean*, Chicago, Ill.

Patton's independent motor car, with gas engine, dynamo, storage batteries and motor, is being tested on the Sixty-seventh street line of the Calumet Electric Railway company, Chicago. Mr. Patton's plan of operation has been heretofore described in this journal.

New General Electric Specialties.

The General Electric company has lately designed several new porcelain wiring appliances to meet the insurance requirements. The cleat is formed of two pieces exactly alike, in which the groove is so shaped that it will take a wire up to 5-16 inch in diameter, and the wires are 2½ inches apart as specified in the insurance rules. The knob is designed to hold wires from 3 16 to ⅜ inch, and do away with the unsightly tie wire. The top and bottom are each provided with four grooves of different dimensions, so that any wires within the range given may be firmly secured. This knob is 1½ inches high and two inches in diameter, the wire being held ½ inch from the ceiling. The floor and window tube has a central hole 5-8 inch in diameter and a head 2¼ inches in diameter. It is 1 3-8

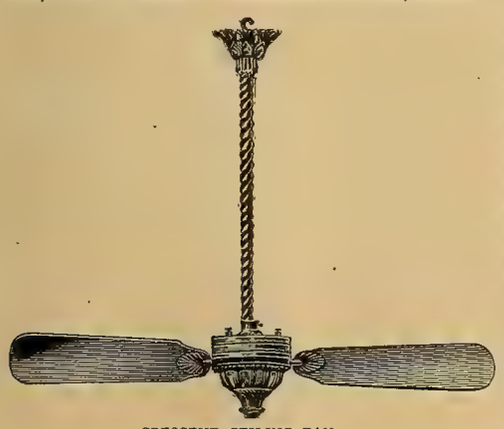


NEW GENERAL ELECTRIC SPECIALTIES.

inches outside diameter and 3¾ inches long. These porcelain appliances shown in the accompanying illustrations, are of the best hard, white, vitrified, non-absorbent porcelain of highest resistance.

Examples of High Class Wiring.

One of the features which the Central Electric company Chicago, has made prominent in its new electrical supply house is to graphically illustrate, as far as practicable, the operation of its electrical machinery and the application of its specialties. This fact cannot but impress a visitor to the store, for, if at all observing, he will notice at once the fine appearance of the interior conduit work in the salesroom. Interior conduit is one of the articles sold by the company, and no better example of this class of work could be found than that installed for safety's sake as well as for its workmanlike appearance in the company's headquarters. The wires are led from the Edison service wires into the conduit, run along the ceiling and dropped for every class of work incident to interior wiring. In some cases this tubing positively adds to the appearance of a room, for when a reflector is desired some distance from the ceiling, the conduit may be dropped to the top of the shade. Helios arc lamps, highly ornamental in appearance, wired two in series on incandescent circuits, are also



CRESCENT CEILING FAN.

supplied with current by wires inclosed in the conduit. Interior conduit is run along the top of office partitions so that lamps may be taken off whenever desired, and the entire arrangement is such that it will undoubtedly be of great benefit to the Central company as a practical advertisement.

In the shipping department, however, an illustration of another system of high grade wiring is exemplified. Here the wires are run entirely upon Hammond cleats, which is another important specialty handled by the company. This wiring, although exposed, is in accordance with the best practice. The wires, by means of their porcelain insulators, are kept at a safe and uniform distance from wood and conducting metals, and thus avoid all possibilities of those accidents which justly or otherwise are too often laid at the door of "faulty wiring."

The company has been unceasing in its efforts to obtain a full and complete line of household goods. It may be safely said that this object has been most successfully accomplished and that a purchaser of annunciators, bells, batteries, and the usual electrical accessories of a thoroughly equipped modern house could have no more complete line to choose from than that of the Central Electric company. These goods are all tastefully arranged in the salesroom. One of the most striking pieces of apparatus shown in the new store is the specimen switchboard of W. S. Hill & Co. It is made of red Tennessee marble and upon it are mounted highly polished and tempered copper switches, including a very large three-way throwover switch and a number of smaller switches, rheostats, relays, etc. All visitors unite in praising the appearance and arrangement of the new store.

A Delicate Fuse and Block.

The question of protection for fine wire, such as used on delicate and costly instruments, and fuses which would be of service for telegraph and telephone work, has long remained a troublesome problem. It has seemed to be impossible to produce a wire from fuse metal by ordinary means which would fuse at as low a current as one-half an ampere. Copper wire drawn to .002 inch is found to carry more than one ampere of current without melting. Various means have been resorted to for making low melting fuses, such as slitting up tinfoil, etc., but without marked success.

The accompanying illustration shows a new fuse link from the laboratory of the Independent Electric company, Chicago, which, it claims, is as true to size and rating as other samples of its tested fuse wire. The wire used in these fuses is produced by a new process from a special alloy, and although expensive, both for the jewel dies and the cost of making, it is found to perfectly accomplish the much desired end. The company is now making fuse links in this form in commercial quantities, which fuse respectively at one-half, three-fourths and one and one-half amperes of current.

Special Receptacle for Shade Holders.

The Bryant Electric company has recently placed upon the market a special receptacle for shade holders, shown in the accompanying illustration, designed somewhat on the pattern of its regular special receptacle. The porcelain in this latter receptacle is shorter, and projecting from the inner side is a brass ring in form similar to an ordinary socket shell. For testing and for temporary display illumination, or for border lights in theaters, this form is very convenient. The Bryant Electric company is noted for the excellence of the material and workmanship in its specialties, and it has been the policy of the company to always make the standard so high that when the name Bryant is attached to any article it is a guaranty of merit. The Grier Brothers, the western representatives of the Bryant Electric company, are now settled in their new office, 1532 Monadnock building, Chicago, ten doors south of their former office and on the same floor.

Crescent Ceiling Fan.

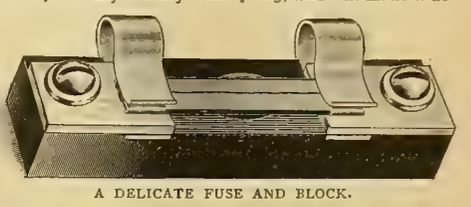
The ceiling fan shown in the accompanying illustration is manufactured and placed upon the market by the Crescent Electric company, Lancaster, Pa., and possesses many pleasing features. This type of fan is provided with its own motor, wound for either 115, 230 or 500 volts, for constant potential incandescent current circuits. Great care is taken with all these fans to produce the highest efficiency, both electrically and mechanically, and they are handsomely finished in antique copper, polished brass, nickel or japan. In addition to the ceiling fan the company is also making a specialty of a column electric fan, which combines a neat, graceful appearance and a capacity for excellent service.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 28.—When Governor Flower signed what is popularly known as the Chamber of Commerce rapid transit bill last Tuesday, he did an act which was very pleasing to the majority of the citizens of New York. The measure has been so thoroughly discussed in these columns that it is unnecessary to again allude to its provisions here. With the governor's signature another step was taken toward rapid transit for the city. Unfortunately the interval between this and the next step will be a lengthy one, for the bill will not become a law until a vote of the people ratifies the action of the Legislature and the governor. With the experience of the old commission to govern it the new body has every opportunity to fulfil its mission, which, to almost every fair thinking New Yorker, means to provide for the construction of an underground electric road. The old commission met Thursday and wound up its affairs preparatory to retirement when the new commission shall qualify. Its session was private and lasted only a few minutes. Upon adjournment Chairman Steinway announced that it had been decided to dismiss the office force, to surrender the lease of the rooms at 22 Williams street, and to turn over all effects to Commissioners Steinway and Starin. This meeting was the two hundred and eighteenth since the commission was organized three years ago last January. It has spent $128,000, besides contracting a debt still unpaid. When at one time it seemed probable that the commission might accomplish something, the Supreme Court authorized it to include in the expenses to be charged to the successful bidder for a franchise compensation to the commissioners at the rate of $5,000 each a year, or $25,000 a year for the board. Since nothing was sold the charge could not be made, and the commissioners have thus practically given their services free. There will be no further meeting unless necessary for the settlement of accounts.

It was reported Saturday that another tie up of the Atlantic avenue trolley system might be expected on June 1st, when the present agreement between the employes and the company will end. The motormen and conductors now receive $2 a day. They want $2.25, and will make a de-

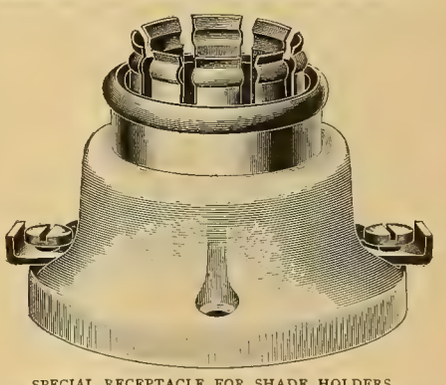


A DELICATE FUSE AND BLOCK.

mand for the increase. If the demand is refused the men will strike. The men employed on the Bergen street and Fifth avenue lines are particularly bitter in their hostility to the company. The Bergen street men did not favor the compromise agreed upon between their representatives and the company last week, and they are ripe for a strike.

William S. Andrews, commissioner of street cleaning, sent out specifications last week for a complete plant for use of his department at Riker's Island for the manufacture and distribution of electrozone. The plant must have a capacity of 4,000 gallons per hour. It is only designed to have a temporary plant of the same capacity, to be operated and manufactured by the contractor for four months and pending the completion of the permanent plant. This electrozone business is in the hands of a company composed of Tammany politicans. Last year improvements were made with the liquid and it was found that it deodorized sewage and street refuse. Plants were erected in several parts of the Croton watershed, and Commissioner Daly has pronounced the results satisfactory.

The informal dedication of the new Postal Telegraph-cable company's building Thursday was concluded with an elaborate dinner. During the afternoon almost everybody in town at all interested in the company inspected the new building at the corner of Broadway and Murray street, and there were telegraphers present from all over this country and from Europe. President John W. Mackay presided at the dinner. The toastmasters were A. B.



SPECIAL RECEPTACLE FOR SHADE HOLDERS.

Chandler, president and general manager of the Postal Telegraph company, and George G. Ward, general manager of the Commercial Cable company. Near by were William H. Baker, vice president of the Postal company; Edward C. Platt, treasurer of both companies; John W. Mackay, Jr., president of the American Torcite Powder company; George W. Tyson, one of the architects of the building; T. J. Wilmot of Waterville, Ireland; S. S. Dickinson of Canso, N. S.; J. Furze of Liverpool, England; E. G. Phillips of London, England; Richard V. Dey of San Francisco, and W. H. Allen of Washington. The building will be opened to the public in about two weeks.

Telephone rates are coming down in New York. A new schedule has just been arranged by which, after June 1st, any person who will agree to do $150 worth of business in a year, or to pay for a thousand calls at the rate of 15 cents a call, may have a telephone. If a subscriber agrees to do more than $150 worth of business annually in this way, the

rate is to be lessened until, when the number of calls reaches 2,000, the charge will be only five cents. At present the rate is $24 a year for a "direct" wire. The small subscribers are the ones who will be benefited by the change. W. F. O.

Milwaukee, Wis.

MILWAUKEE, May 26.—Some inside facts about the Milwaukee street railway combination have just been discovered. It is more of a corporation tangle than is generally supposed. First, as everybody knows, comes the North American company, next is the Milwaukee Street Railway company of New Jersey, chartered in New Jersey, with a capital stock of $5,000,000, and then the Milwaukee Street Railway company of Milwaukee, with a capital stock of $1,000,000. The North American company controls the Milwaukee Street Railway company of New Jersey, and the Milwaukee Street Railway company of New Jersey controls the Milwaukee Street Railway company of Milwaukee. It is a case of wheels within wheels. And there are some other wheels which fit into the wheels which have been described. The Milwaukee Street Railway company of Milwaukee, in addition to owning the old Cream City, Milwaukee City and West Side railway systems, controls the Edison and Badger Illuminating companies and the Milwaukee Electric Railway and the Milwaukee & Whitefish Bay Railway company. The prices paid for these properties were as follows: Milwaukee City railway system, $3,100,000; West Side lines, $1,480,000; Cream City lines, $1,080,000; Milwaukee electric railway, $345,000; Whitefish Bay line, $90,000; Badger illuminating plant, $380,000; Edison Plant, first cost, $200,000. These items make a total of $6,675,000. It is claimed by the officials of the general company that the expense of building new lines, reconstructing old lines and equipping all of them with new cars and with motors, added to the cost of extending the electric light plants, erecting barns and shops, bring the total outlay up to $10,000,000. The total issue of bonds against these properties is $11,250,000. The average cost of building the street car lines, it is asserted, was $12,000 per mile, and the company built 105 miles. On the other hand experienced electricians and street railroad men declare that the company paid a great deal more for the work of construction and for its motors and larger machinery than there was any need for. A construction company figured in the transaction, and the members of the construction company are said to have been identical with the eastern capitalists who managed the deal from the start.

The plan to run a number of double-decked cars on the electric lines of the city will not be carried out. General Manager Wyman declares that these cars are too dangerous and inconvenient. He states that conductors, while climbing on the roof for fares, are unable to look after their cars properly, and that the danger is great. The cars may be all right with mule power, Mr. Wyman says, but with cars bowling along at the rate of ten miles an hour accidents on the steep stairways are too likely to happen. The double-decked car now in the city will be used only in cases of emergency.

The storm last week bothered the street railway company a great deal. Trees fell across the wires, tearing them down for blocks, and seriously affecting the feeders. The work of erecting lightning arresters on the lines had to be suspended. The demands made on the power house were something extraordinary. It required nearly 200 amperes more an hour to propel the cars against the strong wind which blew all the latter part of the week.

The common council of Racine has decided to readvertise for bids for electric lighting. At a meeting a few days ago the committee on finance and a part of the committee on streets reported against the city's buying a line and paying some company for supplying it with electricity, and recommended that the Badger Electric company be awarded the contract for furnishing arc lights at the rate of $66 per year for lights that burned until 1 o'clock in the morning and $80 per year for lights that burned all night. There was a great deal of opposition to the report, and the decision to readvertise was taken after a spirited debate. There is a strong rivalry at present between the Badger Electric company and the Belle City Railway company, and it is thought that the lights can be secured at a much lower rate.

D. W. Stroud, Norman McCarthy, F. S. Maxwell and F. E. Cole, representing the syndidate which is to build an interurban railway from Kaukauna to Oshkosh, were in Appleton, one of the cities along the proposed route, a few days ago. They looked over the ground with a view of selecting the most profitable and satisfactory route. From Appleton they proceeded to Kaukauna and made a similar examination. Mr. Stroud stated that the line was a certainty. The right of way has been secured from almost every property owner on the route, the consent of every township included in the route had been secured, and arrangements had been made to call special meetings of the county boards of Outagamie and Winnebago counties for the purpose of acting upon the question of franchises. The work of building, Mr. Stroud said, would be commenced just as soon as franchises had been granted, and it was expected to have the line running by January 1, 1895. The company asks for nothing except the franchises. It is probable that the route will be from Oshkosh by way of the Northern Insane Hospital, to Neenah, thence along the lake shore to Lochhyrst and Waverly Beach, thence by the lake shore to Appleton, and thence by the Little Chute and Kaukauna roads to Little Chute and Kaukauna. The cars will be 50 feet long, heavily built, with all the latest improvements. They will be capable of running a mile in two minutes. They will be run every hour at least, and every half hour if the traffic warrants. C.

St. Louis.

ST. LOUIS, May 26.—About three months ago a subway commission composed of the mayor, Prof. Winfield S. Chaplin, chancellor of Washington University, Robert E. McMath, president of the board of public improvement, Albert Arnstein of the city council and William H. O'Brien of the House of Delegates, was organized for the purpose of devising ways and means of putting all wires underground. The result of the labors of the commission is that two ordinances have been drawn up, one of which authorizes the city to construct, own and operate a conduit system having sufficient capacity to accommodate all wires in the central part of the city; the other ordinance regulates the use of the conduits and provides for their supervision and maintenance.

The city counselor has lately given an opinion that the city has no power to order that electric wires be placed underground until underground facilities are provided either by the city itself or some private corporation.

The Johnstown welding machine is now engaged in welding the new track of the Baden & St. Louis Railroad company, which is being changed to an electric road. This road was formerly a single track horse road about three and a half miles long, extending from the north end of the Broadway cable line to Bellefountain and Calvery cemeteries and to Baden, the extreme northern city limits. It is now owned by the Broadway Cable Line company and will be operated as an extension. It is now being relaid with a double track of heavy Johnstown girder rail. This is the first time any welding has been done on new rails, and some difficulty was encountered at first in keeping the rail joints in proper alignment while welding, the weight of the machine having a disturbing effect. These difficulties were overcome, however, and everything is now working smoothly. This machine makes a side weld instead of an end-to-end weld as formerly used. The welding car is fitted out entirely with the Thomson welding apparatus. Current is taken from an overhead wire which was erected in advance. A motor generator converts the current into an alternating current of a slightly lower voltage, which is again changed by a converter which forms a part of the welder to about four volts with a current varying from 4,800 amperes downward.

The St. Louis Underground Service company is extending its conduit system from the main Broadway conduit down Olive street to the main office of the Postal Telegraph company, which is located at the corner of the alley between Fourth street and Broadway. This extension is to enable the Postal Telegraph company to make use of the conduits of the Subway company. All wires of the Postal Telegraph company will be put into the conduit as far as possible, a contract to this effect having been entered into about three weeks ago. In this extension cement lined pipe is being used instead of the asphalt concrete conduit system formerly used by the Subway company. Charles Sutter, the president of the Subway company, has decided to use the cement lined pipe conduit system in all extensions hereafter. S. O. B.

PERSONAL.

L. A. Ferguson, electrical engineer of the Chicago Edison company, has just returned from a business trip through the East.

E. Kuhlman and William Hornberger of the Hornberger Electrical Manufacturing company, Elkhart, Ind., were in Chicago last week.

Major A. J. Gifford has been appointed purchasing agent of the Chicago office of the General Electric company in place of H. L. Monroe, who will have charge of the company's office at Dallas, Tex.

A. P. Munning, well known in electrical circles through his connection with the Edison General Electric company, H. Ward Leonard & Co., the General Electric company, and lately with the Anaconda Mining company, is now with the Central Electric company, Chicago.

NEW INCORPORATIONS.

Inland Electric company, Chicago, Ill.; capital stock, $100,000; Carl Pehrson, Chicago.

General Electric company, St. Augustine, Fla.; capital stock, $50,000; to generate electricity for light, heat and power for public and private use; Albert T. Best, St. Augustine, Fla.

Illinois Electrical Reminder company, Chicago, Ill.; capital stock, $25,000; to deal in electrical goods, machinery, etc.; W. Clyde Jones, Monadnock building, Chicago, Ill.

Montauk, Orient & New York Telephone & Telegraph company, New York, N. Y.; capital stock, $5,000; to construct a telegraph and telephone system; B. H. Reeve, Greenport, N. Y.

Colonial Telegraph & Telephone company, Niagara Falls, Ont.; capital stock, $25,000; to conduct a telegraph and telephone business; James Bampfield, Niagara Falls, Ont.

ELECTRIC LIGHTING.

Shannondale, Ind., is negotiating for an electric lighting plant.

Arrangements are being made to install a new incandescent lighting plant at Orillia, Ont.

The Butte, Mont., Lighting company, with a capital stock of $1,000,000, has been organized.

Newark, O., is to own its electric light plant. The trustees are S. J. Ewing and C. W. Miller.

At a recent election at St. James, the Minn., people voted to establish an electric lighting plant and a system of water works.

Caldwell, O., is taking steps to secure electric lighting. The town council has been visiting a number of plants for the purpose of securing information regarding the subject.

The question of street lights is at present agitating Parkesburg, Pa. For five years the thoroughfares have been illuminated with gasoline, but electricity is now desired.

London, Ont., recently advertised for bids for electric lighting. Only one company responded and its prices were so high that it is likely that gas lamps will continue to light the city's streets.

The proprietors of the Fitchburg, Mass., Gas & Electric Light company have closed a contract with the Fort Wayne, Ind., Electric company, for a 75 arc light dynamo, which is to be put in position at once.

The power house of the electric light company at Nanaimo, B. C., was completely destroyed by fire with its contents last month. The loss is estimated at $65,000. The property was only partially insured.

The new municipal lighting plant at Little Rock, Ark., has recently been completed, and City Electrician Fish celebrated the event by giving a dinner to the city officials. The plant has at present a capacity of 240 arc lamps of 2,000 nominal candle power each.

The Martins Ferry, O., council has passed a resolution asking the Ohio Legislature to pass an act authorizing the voters to vote upon the question of issuing $30,000 bonds to build an electric light plant. The city has been without electric light since the old plant burned some time ago.

The contract for electrically lighting the streets of Waukegan, Ill., for a term of five years has been awarded to the Waukegan Electric Light company at $75 per lamp of 2,000 candle power, Philadelphia moonlight schedule. A saving of $3 per lamp has been made by the city in the new contract.

The trustees of the village of Geneseo, N. Y., have awarded the contract for the public lighting to the Geneseo Gas company, which will at once put in an electric plant of the Wood type. The company agrees to maintain 1,200 candle power arcs, on a moonlight schedule, for $65 each per year, and to maintain 16 candle power incandescent electric lamps for 70 cents each per month.

Sandy Hill, N. Y., has been in darkness for about two months owing to the defeat of the electric light appropriation. Those who voted against the appropriation have repented, and at a meeting of the village trustees lately they sent in a petition asking the trustees to take some action to provide lights. The trustees will enter into a contract with the local electric light company immediately.

A suit has been brought by T. J. Preston & Co., linseed oil manufacturers, Newark, N. J., against the Newark Electric Light & Power company, in which the plaintiffs claim $100,000 damages occasioned their works by vibrations caused by the engines and machinery of the electric light company. T. J. Preston & Co. erected brick buildings on foundations in "made land" on the Passaic river front, in 1886, and five years later the electric light company built alongside. The latter's engines and machinery, it is claimed, shake the neighborhood for 1,000 feet around. Preston & Co. claim their buildings are now six inches out of plumb, and that the vibrations have seriously affected the business in which they are engaged, in that the shaking of the premises so disturbs the contents of the tanks that fine oil is an impossibility, and since 1891 the product is only salable at a price below the market rate. The de-

fence is that the vibration is exaggerated, and that the alleged crevices in the walls either do not exist or are trivial; further that the Preston company recently had a severe fire in its premises, in the course of and as a result of, which, the walls of the buildings were more or less damaged.

ELECTRIC RAILWAYS.

The citizens of Cardington, O., may establish an electric railway system.

It is anticipated that Bridgeport, Conn., will be supplied with electric cars this summer.

A movement is being contemplated to connect Washington Grove and Sandy Springs, Md., by an electric railway.

The electric railway between Bordeaux and Vousche, France, has proved so successful an enterprise that the company is extending its lines. American electric railway apparatus is employed.

It was decided some time ago to equip the old horse car line running through Canandaigua, N. Y., to Canandaigua lake with electrical apparatus. Work has been progressing for some time, and it is likely that the new road will be in operation by July 1st.

The promoters of the new electric railroad between Rockford, Ill., and Dixon recently held a meeting in the latter city, at which it was decided to build at once between Oregon and Dixon. J. S. Ticknor of Rockford is president of the company.

Business men of Evanston, Winnetka, Wilmette, Kenilworth and Glencoe, Ill., met in Evanston last week and organized a permanent improvement club, the object of which is to secure an extension of the Chicago North Shore Electric street railway as far as Glencoe.

Two ordinances granting permission to the West End Electric company, Philadelphia, one to construct an underground system on streets between Broad and Twentieth, Girard avenue and Master street, and the other between Broad street and the Schuylkill river, Callowhill and Poplar streets, have been referred to the Philadelphia councils' electrical committee.

An electric railway has been projected to connect Brazil and Terra Haute, Ind. Robert Smith of Terre Haute represents the new enterprise. The right of way, which has already been partially secured, is executed to Max Joseph and Robert Smith of Terra Haute, and is conditioned on a fifteen cent fare one way or twenty-five cents round trip, less than a cent a mile.

On removing the tracks of the horse car construction on Prytania avenue, New Orleans, La., preparatory to the electric construction, the cypress ties, which had been in service for about 30 years, were found to be in so sound a condition that they were employed in the new construction, resulting in quite a saving, as new ties had been distributed over the route before the work had been begun.

About 250 men were put to work May 21st upon different sections of the tracks, laying new rails, ties, and preparing for the erection of the trolley wires in East Boston, Mass. The new electric cars are being made in St. Louis and will be very fine. It will be necessary to erect a power house, probably at the foot of Falcon street, near Meridian. The estimated cost of the plant, buildings, etc., is about $50,000.

The Lakeside electric railway, running from Mahanoy City, Pa., to Shenandoah, a distance of 5½ miles, which is to be extended to Delano and Lakeside Park, making a total length of 13 miles, was formally opened for travel last week. About 100 invited guests, including a number of prominent bankers and business men of Philadelphia and New York, and newspaper representatives from the mining towns in the neighborhood, were present and rode over the line.

A New York daily, commenting upon the electric lines in Brooklyn, has this to say: "The trolley system commands the local transit situation. The increase in traffic on the electric lines surpasses the most extraordinary expectations of the management. The crowding of the cars is not confined to the so-called 'rush' hours, when passengers are going to and from their business. It is particularly noticeable in the forenoon, during the time set apart for shopping. Along Fulton street and Flatbush avenue, in the retail dry goods district, it is not unusual to see seventy or eighty cars so close together that they resemble a 'solid' train. The demand for seats is so heavy that the rolling stock in use supplies it insufficiently. At the present rate of development the railroad companies will have to largely increase the number of cars."

About 2,000 taxpayers and residents along the line of the proposed extension of the Electric Traction company's Fifth and Sixth streets railway in Philadelphia have held special meetings and signed petitions requesting the councils to pass an ordinance now before them in this behalf. The new lines or extensions from Franklinville would reach a territory in which over 3,000 lots have been sold. Many dwellings would thus be erected if rapid transit were thus extended. The projected lines will extend up the Kensington and Oxford turnpike to Fox Chase, passing through the villages of Wyoming, Olney, Lawndale and Cheltenham, with branches on Wyoming avenue, Oxford road and Arrott street to Frankford; also on Fifth and Sixth streets to the county line.

Some very quick work in electric railway construction was recently performed on West State street, Trenton, N. Y., by the Passenger Railway company of that city. The erection of poles, it was known, would be strenuously opposed by certain residents of the street, on which are located the homes of some of the most prominent and wealthy residents of the city. For this reason, the company's workingmen did not commence the work of overhead line construction until late on the afternoon of April 6th, and by 11 o'clock the following morning electric cars were running over the road. The day before not a single evidence could be seen of the company's intention to put up the wires. A few of the residents commenced hostilities as soon as the intention of the railway company was evident. Its workmen were assaulted with brooms, water and other weapons, and a judge was called out of bed at five o'clock in the morning to grant a writ of mandamus, but the railway company secured its point.

MISCELLANEOUS.

A movement is on foot to reorganize the Schuyler Electric Light company of Middletown, Conn.

The Interstate Construction company of Des Moines, Ia., with a capital stock of $500,000 has been formed to engage in electrical construction work.

Under the title "The Latest" the London *Electrical Engineer* speaks of "a penny-in-the-slot electric boot-cleaning machine" and expresses a desire to see it. Such machines have been in existence in the United States for several years, and one was on exhibition at the World's Fair.

An officer of a Cuban street railway company who was recently in New York securing bids for electric railway construction was the shipper of the large cargo of arms and ammunition on the Alert, intended for Cuban insurgents. The ship was captured by the authorities of that island.

Recent Swedish reports say that an application of electricity to the smelting of iron is to be tried on a commercial scale at Trollhattan, in Sweden, where great water power is available to run the dynamos. The process is the invention of G. de Laval, whose steam turbine was exhibited at the World's Fair.

The General Electric directors have elected Robert Treat Paine and Gordon Abbott, both of Boston, as directors to fill the two new seats created by the stockholders at their annual meeting. The old officers were elected with the exception of M F. Westover, who was chosen secretary, as previously announced. The directors discussed the matter of the impairment of the capital stock, and referred it to the executive committee.

The committee of electrical men appointed for the purpose of devising a way by which most of the electric wire bearing poles south of Thirty-ninth street, Chicago, may be done away with has finished its work. As far as practicable the poles on one side will carry wires of heavy voltage and those on the opposite side those of light voltage. The company which first puts up a line of poles will maintain its line; all others will take up their poles and pay rental to the first company.

Tweedale & Smalley, textile machinists, Castleton, near Rochdale, England, have in operation a system of electrical shunting and hoisting at their new works. The raw goods are backed into the siding by the railway engines, and are then taken wherever required by a small electric locomotive, current being furnished by the overhead wire system. All the loading and unloading is done under cover, and the trucks can afterwards be run on to the separate sidings for dispatch in either direction. The packing room is also provided with an electrical crane for hoisting the machinery either on to the railway wagons or on to lorries, as may be desired. The electrical energy is supplied by a dynamo in the main engine room of the works, and is driven by the horizontal tandem compound engine which runs the entire works.

TRADE NEWS.

Kohler Brothers, the western agents of the Walker Manufacturing company, and the Eddy Electric Manufacturing company, have removed their offices to the fine suite at 1644–1648 Monadnock building, Chicago.

The Cummings electric carriage illustrated last week in the WESTERN ELECTRICIAN is equipped with chloride accumulators made by the Electric Storage Battery company of Philadelphia.

The Central Electric company, Chicago, has placed its line of new Lundell fan motors upon the market, and has a full line for inspection in its new store upon Adams street. The '94 type of this motor contains some improvements such as a larger sized oil cup, and a larger brush as well as an advance in the construction of the brush holder.

The adaptability of the Packard Mogul lamp for large interior lighting and also for outdoor lighting under special conditions is becoming more apparent as the lamp becomes more extensively introduced. The Electric Appliance company, Chicago, has sold during the last week a number of complete Mogul lamp equipments for theater and hall lighting, in addition to two or three outfits for outside work, as a substitute for arc lamps.

The Metropolitan Electric company, 186 and 188 Fifth avenue, Chicago, has just received a large stock of fan motors for desk and bracket service. The demand for this comfort-giving article continues to increase, and no better indication of its efficiency and reliability can be desired. The Metropolitan incandescent lamp continues to shine in many new installations, and is not being overlooked by the contractors of the West. The demand for P. and B. products continues unabated in the West. In spite of the large stock which the Metropolitan company has been carrying, it has proved inadequate to fill the orders which have kept the company so busy.

A few plain facts concerning water tube boilers have been embodied in rather an extensive book published by the Abendroth & Root Manufacturing company, 28 Cliff street, New York city, which is called by the company "Information Pamphlet, No. 3." Naturally the reading matter is devoted almost entirely to a description of the improved Root water tube boiler, which is shown in very satisfactory illustrations and drawings in detail and in process of construction. The description of the boiler is exhaustive, and every point of merit is carefully brought out. Interesting tables and diagrams add materially to the value of the book which will undoubtedly be widely circulated and read.

Great credit is due to the Card Electric company, Mansfield, O., for the handsome catalogue it has just issued descriptive of the company's single motor equipment for street railways. The book is a pretentious one, and contains some very satisfactory illustrations of the subject matter. The Card Electric company manufactures, among other machinery, complete street railway equipments, multipolar reversible motors for rolling mills, hoisting apparatus, bridges, turntables. It also makes a specialty of slow speed iron clad stationary motors and dynamos. The idea of the book in question, however, is to thoroughly describe and illustrate the company's single motor equipment. With this end in view every detail of the apparatus has been photographed and reproduced in half tone work. Opposite each picture an elaborate description of the part displayed is presented, as well as a great deal of information regarding electric traction in general. The book is one that should be of interest to street railway men and promoters of electric railway enterprises.

The last catalogue and price list of the Vulcanized Fiber company, whose office is at 14 Dey street, New York, with a factory at Wilmington, Del., reveals a number of new applications of vulcanized fiber, and illustrates many of its valuable merits. Vulcanized fiber has now been upon the market for over 20 years, and is recognized as a staple article of commerce in all portions of the world, being used largely for railway, electrical and general mechanical purposes, and possessing peculiar qualities which render it entirely different from any other known material. It is made of two classes, hard and flexible, as desired, according to the use for which the goods are intended. The hard fiber closely resembles horn in its consistency, is exceedingly tough and strong, resisting an enormous compressive strain, and retains its elasticity under all ordinary temperatures. The flexible fiber has the appearance of a very close-grained sole leather, and is used for a great variety of purposes. Both hard and flexible fiber improve by seasoning, and both are entirely free from grit.

BUSINESS.

The Central Electric company, Chicago, has added a book department to its list of features. All of the standard electrical works of value have been collected together and will be kept constanly in stock.

The General Electric company has closed the contract for the Poughkeepsie & Waffingers Falls railway of Poughkeepsie, N. Y., covering two 200 kilowatt, direct connected generators, 40 G. E. 800 motors and type K controllers.

The Allen-Hussey company, Chicago, has removed its office to 818 Medinah building, Jackson and Fifth avenue. Here the company, which is engaged in a contracting and general electrical business, will have increased facilities and room for conducting its business.

Henry F. Kellogg, general selling agent of the Whitney Electrical Instrument company, is spending a few days in Chicago in the interests of his company. Mr. Kellogg is on a trip to the Pacific coast and he will visit most of the principal cities between here and San Francisco.

R. K. Roney of Westinghouse, Church, Kerr & Co., Boston, is in Chicago on a business trip. He is the patentee of the well known Roney mechanical stoker and is engaged in working up some important enterprises connected with the introduction of the mechanical draft system in conjunction with the Green fuel economizers.

Among the principal contracts closed by Goltz & Sinclair, Milwaukee, Wis., the following may be mentioned: Wiring Milwaukee exposition building for 600 lights; installing two General Electric 50 horse power waterproof motors and all the necessary gearing for the Holton street folding bridge, Milwaukee; re-wiring the Herman Zoehrlaut tannery, and installing an 800 light insulated plant for Keenan building, Milwaukee.

The requirements of the fire underwriters in the majority of the large cities have recently been made to call for globe nets over all arc lamp globes to prevent the globes from falling to pieces when broken on the lamp. The Electric Appliance company, Chicago, is furnishing a special globe net for this work in different sizes adapted for different sizes of globes, and is meeting with as much success in their sale as it has had with the Acme expanding wire guard for protecting incandescent lamps.

The National Water Tube Boiler company, which has extensive works at New Brunswick, N. J., with offices in New York, Philadelphia, Chicago and St. Paul, held its annual meeting at the main office May 16th, at which gratifying reports were made of the business of the fiscal year. While the financial depression checked the output of the summer months, later and recent business nearly reached that of similar months in preceding years. In corroboration of the satisfactory reports, a cash dividend of five per cent. on the $100,000 capital stock was declared out of the profits, leaving still a surplus for future contingencies.

Ruberoid is the name of a new flexible tubing for inte-

rior wiring which is being put upon the market by the Metropolitan Electric company, Chicago, which has been appointed the western selling agent. This tubing has been tested by experts and is said to be absolutely waterproof and to resist acids and alkalies. It has already been placed in several large installations, and as no elbows or couplings are necessary, it will doubtless attract attention among architects and contractors. I. X. L. weatherproof wire, though only on the market in the West for a short time, has met with unqualified success. It is a very high grade wire, and the testimonials which the manufacturers have received have been of a very satisfactory character. The Metropolitan Electric company has received quite a few large orders for this wire during the last week.

The Hartley Electrical Works, Chicago, have just opened an office and factory at 373 Dearborn street, and are now in a position to attend to their special line of business with improved facilities for superior work. The works are fitted with the latest and most improved appliances for doing all kinds of repair work on every kind of electrical apparatus and parts pertaining thereto. The workmen are men selected for their skill and experience in their respective lines. The firm is especially prepared for the rewinding of armatures from the smallest to the largest and has had a wide experience in the building and repairing of converters. B. Hartley, the manager, has had an experience of 12 years of practical work, and has been connected with one of the largest and most successful builders of electrical machinery in the country.

The Frisbie Elevator & Manufacturing company, New Haven, Conn., is one of the few concerns which has not felt the business depression badly; its factory has been in operation to supply a generous number of orders and the company is now adding to its help to meet the increase in trade. March and April were the largest months of the company's business since the existence of the company. General Manager F. A. La Rue is pushing the Frisbie elevator in no uncertain manner and the results show his efforts have not been in vain. He reports among the many contracts recently secured a large order for Frisbie clutch pulleys and cut-off couplings, patent pillow blocks, hangers, shafting, etc., for the New Haven, Conn., Electric Light company's new station; a 2,000 pound Champion safety freight elevator of the company's new friction pulley pattern for the E. S. Greeley & Co.'s new building at 5 and 7 Day street, New York; a five ton freight elevator of the same pattern for the Safety Insulated Wire & Cable company, West Twenty-eighth street, New York, and many others.

The horizontal-magnet D'Arsonval galvanometer, manufactured by Queen & Co., Philadelphia, is an extremely valuable instrument for making insulation resistance tests on wires and cables. For the most of this work it is much superior to the Thomson mirror galvanometer, it is claimed. The manufacturers say that on account of its very pronounced dead-beat qualities, measurments are made much more quickly and it being but little affected by vibration, and not at all by external magnetism, it can be employed where the Thomson would be utterly useless. It is commonly supposed that a Thomson is vastly more sensitive, but this is denied. With the 1,000 ohm coil D'Arsonval a sensibility of 315 megohms can be obtained. An exceedingly valuable feature is the arrangement for interchanging coils for different classes of work. To do this it is only necessary to draw out one tube and insert the other, the instrument then being ready for use. Among prominent users are the Philadelphia Traction company, the Electric Traction company of Philadelphia, the Standard Underground Cable company and Roebling's Sons.

The Harrison International Telephone company, which was organized under the laws of the state of Illinois, and which has an office in the Chamber of Commerce building, Chicago, has introduced to the public a telephone and telephone system which has been installed to a considerable extent since the expiration of the Bell patents. Regarding the question of possible infringement the legal opinion of several prominent attorneys is of much interest. Witter & Kenyon, New York city, in a statement regarding the Berliner patent say: "In our opinion your telephone does not infringe that patent nor any of its claims, and can be made and used without regard to that patent, whatever be its fate in the pending government suit to repeal it. The Berliner patent only covers the use of electrodes that are in constant contact and that operate by variations of the pressure of contact. Your telephone operates by a making and breaking of contact. Its electrodes are not in constant contact. The Berliner, like the Bell telephone throws upon the line wire an undulatory current. Your telephone throws upon the line wire a pulsatory current." Eugene Clark, solicitor of patents at Washington, says: "It is an interesting fact that the Harrison telephone, covered by the above patents, was practically used in an exchange system for many years before the patents were finally issued, and during such use Dr. Harrison successfully defended his invention in a suit brought against him by the Bell Telephone company. The court refused to grant an injunction, and the Harrison telephone exchange continued in successful operation. Many exchanges with Harrison telephones have since been installed and put into successful operation. The fact of the Harrison telephone having successfully passed through this litigation is very favorable to your patents." Other lawyers, after carefully considering the claims for the Harrison instrument, have given equally favorable opinions. This telephone was described and illustrated some time ago in the columns of this journal.

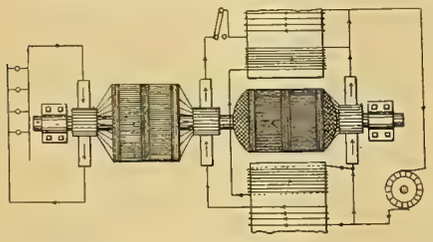
ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued May 22, 1894.

520,033. Electric Battery. H. W. Burnham, Newton, Mass.

520,050. System of Electrical Conversion and Distribution. T. H. Hicks, Detroit, Mich.

This invention consists in a system of electrical distribution and conversion of the combination of a motor, a converter, a main continuous current supply station, a sub-station and an external work circuit; the motor armature and the converter mechanically joined and rotatable together; the work circuit supplied with a converted current; the motor field magnets wound with supplemental coils, a continuous current flowing through coils in a direction suitable for decreasing the motor field magnetism, the current being governed by the work done



NO. 520,050.

in the work circuit; the main station supplying the sub-station with continuous current and the sub-station supplying the work circuit with a converted current of lower potential than the main supply current.

520,061. Railway Signal Device. F. E. Kinsman, Plainfield, N. J.

520,062. Apparatus for Controlling the Movement of Railway Trains or Vehicles. Frank E. Kinsman, Plainfield, N. J.

520,072. Pedal Governor for Electric Motors. A. G. McKee, State College, Pa.

520,083. Telephone Trunk Line System. J. I. Sabin and W. Hampton, San Francisco, Cal.

520,086. Telephone. H. F. Slocum, New York, N. Y.

520,088. Incandescent Lamp. F. S. Smith, Pittsburg, Pa.

520,106. Transmitting Sound. H. B. Cox, Hartford, Conn.

520,108. Electrical Train Brake. Wendell C. Fletcher, St. Louis, Mo.

520,111. Electric Locomotive. Rudolph M. Hunter, Philadelphia, Pa.

520,120. Galvanic Battery. Edwin F. Northrup, Ardmore, Pa.

520,127. Annunciating Apparatus. Horace E. Walter, Richfield Springs, N. Y.

520,128. Switchboard for High Tension Circuits. James J. Wood, Fort Wayne, Ind.

520,129. Electric Current Indicator. James J. Wood, Fort Wayne, Ind.

520,143. Former for Winding Armature Coils. Harry L. Kirker and William Chambers, Pittsburg, Pa.

520,152. Electric Machine or Electric Motor. Robert K. Welch, Philadelphia, Pa.

520,156. Electric Railway Trolley. Thomas M. Brown, Cleveland, O.

520,169. Brush Holder for Dynamo-electric Machines or Motors. Andrew L. Riker, New York, N. Y.

520,124. Electric Clock Striking Mechanism. Fred G. Gregory, Chicago, Ill.

520,213. Trolley Wire Hanger. Thomas J. McTighe and Sumner W. Childs, New York, N. Y.

520,223. Electric Advertising or Signaling Apparatus. George L. Schneider, San Francisco, Cal.

520,228. Electric Locomotive. Rudolf Eickemeyer, Yonkers, N. Y.

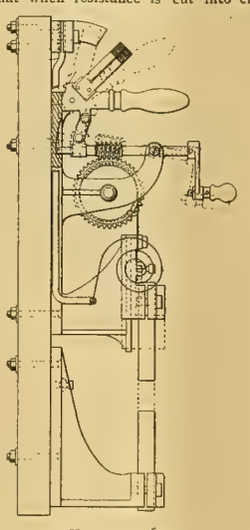
520,232. Electric Arc Lighting System. D. Higham, Boston, Mass.

520,234. Indicator for Fire Alarm or Other Purposes. William H. Kirnan, Bayonne, N. J.

520,246. Automatic Telephone System. Louis E. Simoneau, Montreal, Que.

520,263. Carbon Switch. Friedrich von Hefner-Alteneck, Berlin, Germany.

The invention consists of a carbon switch device so constructed that when resistance is cut into circuit by it the



NO. 520,263.

mechanism will automatically adjust itself in readiness for convenient and positive operation for regulating the resistance by separating the switch carbons or fusible contacts more or less to control the length of the electric arc formed between them.

520,264. Commutator. Carl Hoffmann, Berlin, Germany.

520,267. Electrical Governor. William H. Miller, New York, N. Y.

520,274. Electric Railway. Ernst Werner von Siemens, Berlin, Germany.

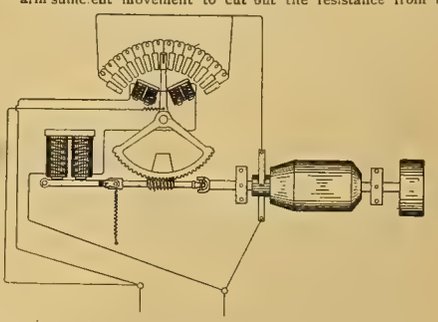
This invention comprises principally in an electric railway system an overhead tubular conductor extending along the line of railway and having a longitudinal slot, a traveling contact within the tubular conductor, the contact having a yielding or flexible connection extending through the longitudinal slot to an electrically propelled car.

520,279. Electric Switch. Henry E. Werline, Lancaster, Pa.

520,280. Automatic Device for Removing Resistances in Starting Electric Motors and Replacing Same. George H. Whittingham, Baltimore, Md.

Claim 1 reads:

In an automatic starting device for electric motors, the combination of a motor, a resistance for starting said motor, a series of contacts connected with the resistance, a toothed arm carrying a contact shoe in engagement with said contacts; a worm adapted to engage said toothed arm when starting the motor, but disengaged therefrom when the motor is not running, mechanism to engage the worm with said toothed arm at the time of starting the motor, whereby the worm imparts to the arm sufficient movement to cut out the resistance from the



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motor circuit, and means whereby the contact shoe is returned to the point of greatest resistance when the worm is disengaged from the toothed arm.

520,299. Apparatus for Heating Metals Electrically. Charles L. Coffin, Detroit, Mich.

520,300. Method of Heating, Welding or Working Metals Electrically. Charles L. Coffin, Detroit, Mich.

520,304. Conduit Electric Railway. William R. DeVoe, Shreveport, La.

520,306. Telephone Transmitter. Henry M. Goodman and John Goodman, Louisville, Ky.

520,318. Combined Cut-out and Cord Adjuster. Edgar D. Knap, Schenectady, N. Y.

520,323. Block System for Trolley Railways. Willard F. Lewis, Swampscott, Mass.

520,329. Overhead Trolley Conductor. Robert Muir, Brooklyn, N. Y.

520,340. Electric Traction Apparatus. Paul Schoop, Zurich, Switzerland.

520,351. Electrical Conduit Mechanism. John F. Blake, New Haven, Conn.

520,356. Conduit Electric Railway. C. W. Siemens, London, England.

520,359. Apparatus for Electric Welding. Rudolph M. Hunter, Philadelphia, Pa.

520,360. Apparatus for Electric Welding. Rudolph M. Hunter, Philadelphia, Pa.

520,361. Electrical Measuring Instrument. Rudolph M. Hunter, Philadelphia, Pa.

520,365. Visible Signal Device. William H. Lane, Brooklyn, and Frederic Sperrin, New York, N. Y.

520,367. Insulator. Fred M. Locke, Victor, N. Y.

520,378. Multiple Electric Fuse Box. Edward A. Parson, Ottawa, Ont.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, JUNE 9, 1894. No. 23

Electric Scenic Theaters in the Masonic Temple, Chicago.

The love of the American people for anything that is novel and pleasing to the eye was abundantly exemplified last year at the electric scenic theaters at the World's Fair. These places of amusement were among the most popular places at the exposition, and they have since been widely imitated and reproduced, sometimes with extended improvements and with more attention paid to detail. Those in Chicago who did not enjoy the opportunity at the fair of seeing the scenic effects which were produced upon stage pictures by the aid of electricity, and who were not able to avail themselves of the chance offered by Steele MacKaye's spectacle, the "World Finder," at his suddenly terminated venture in the "Scenitorium," may gratify their tastes for amusement of the sort in the recently opened summer garden on the roof of the Masonic Temple. The garden in itself, 302 feet from the ground, is a sufficient attraction to draw crowds. Interest, however, centers in the two scenic theaters which are located in small houses, reminding one forcibly in style of decoration of the general idea of the World's Fair buildings. Each theater is designed to accommodate about 75 persons comfortably, and opera chairs to that number are provided. In the first theater an Alpine scene is presented, the scenery of which, although very pretty, recalls too forcibly the theaters which were made familiar last summer. A mountain stream forms the motive of the picture. Upon its banks the houses are built; a church stands near by, while a mill in the foreground presents an opportunity for a waterfall, after the water has passed over the mill-wheel. A bridge spans the stream, over which villagers pass to and fro; upon a mountain side stands a castle, while snow-capped peaks stand out in relief against the sky. The scene is called "A Day in the Alps" and begins with midnight, by the tolling of the bell. The break of dawn and the heralding of day present a faithful resemblance to the original and is particularly well done. After the day has been begun, a thunder storm approaches and passes over, accompanied by vivid flashes of lightning and the roll of heavy thunder. The evening is accompanied by the lighting of the street and house lights, and the moon rises, until the clock again announces twelve. The scene is shown upon this page, Fig. 3. Back of the scenes a complicated mass of electrical apparatus explains many of the pretty atmospheric changes. It is not the intention of this article to describe in detail any of the devices employed, for many of them were devised to suit the requirements of this particular case, and the others have been already mentioned in the columns of this journal. Focusing lamps, rheostat boxes, switches, reflectors and many devices of a similar character are present in abundance and are confined in an extraordinarily small space for the many effects produced.

The second theater presents as a stage setting the view of the Court of Honor at the World's Columbian Exposition, looking northwest from the west end of the agricultural building, and is most perfect in point of detail. The scene is introduced in the morning, and the sunlight illumines the buildings, including the palace of mechanic arts, administration building, electricity building, as well as the MacMonnies and the two electric fountains. The lagoon is well supplied with gondolas and electric launches, which, although stationary, add much to the scene. In detail the scene is perfect. The statues are faithfully reproduced, and one has but to close one's eyes and listen to the music which accompanies the scene, to imagine that the band in the band-stand really is playing and that the crowds are not mere paste-board fancies, but are living beings admiring in a wondering way the beauties of the departed White City. The approach of evening presents the finest opportunity for a display of the resources of electricity in the presentation of this scene; as dusk advances the lamps scattered throughout the grounds are lighted, the stars begin to shine, now one building after another is illuminated, and soon the border of cornice lights, which extended around the Court of Honor and which was so much admired at night, adds its long lines of light to the scene. Searchlight effects flash from one building to another, and administration building, with its handsome decorative lighting scheme, shines resplendent under these streams of light. At last the lights are dimmed and the electric fountains, this time, fortunately, unaffected by the winds, begin to play. Many of the designs employed upon the fountains at the fair are used here, and the interior illumination, made by a Packard mogul lamp of 300 candle power, presents the usual changes and studies in color. When the display reaches its end the evening is far spent and the moon is seen in a locality warning the fair visitors of the approach of midnight. Perhaps because of its reproduction of a scene that is held in such regard by those who visited the fair, the second theater seems more attractive to all but those who have some idea of how all of these effects are produced, for the possibilities of the Alpine scene are much greater in regard to electrical effects. The scene in Fig. 2 shows the fair at midday. The second theater is provided with the luxauleator or curtain of light, originally designed by Steele MacKaye and illustrated and described in the WESTERN ELECTRICIAN of February 24, 1894. It consists merely of a border of incandescent lights around the stage opening. It is outlined in Fig. 2. In the Alpine scene 160 16 candle power and 20 one candle power incandescent lamps are used, and in the other scene no less than 100 one candle power lamps, taking four volts, are used alone.

While the theaters are the most interesting from an electrical point of view, the garden itself is not without electrical attractions, and more are to be added, which will equip it with some of the finest of display lighting. It is the intention of Sosman & Landis of Chicago, the scenic artists under whose management the venture is being run, to make the place both attractive and cool, and potted plants, flowers, flags, paintings, fan motors and ventilating fans are abundant. From the roof hang vari-colored prismatic glass globes containing incandescent lamps, and refreshment booths, electric organs, phonographs and other electrical and mechanical devices are furnished for the amusement of visitors. Upon entering the building a visitor's attention is attracted by a large sign composed of incandescent lamps in the form of a hand pointing upward and the words "Electric Scenic Theaters." From the tip of the forefinger of the hand a row of lights extends upward the entire height of the building to the garden. This is called a "chaser," and the lamp globes are of different colors. By means of a switch light passes along the line, changing in hue as it ascends, until it reaches the glass roof of the building, from which are suspended over the court three chandeliers of incandescent lights, connected by radial lines of lamps, an idea of which, as well as a partial view of the garden, is presented in Fig. 1. There are 105 red, white and blue lamps in the central cluster and 84 in each of the others, while the radial lines are composed of 240. There are 175 lights in the "chaser" and 234 in the hand and sign. By means of the same switch which regulates the light upon the "chaser," patterns of pleasing figures are formed upon the court decoration. This switch, as well as many of the devices in the theaters, was designed and built by C. D. Baker, the electrical engineer for Sosman & Landis, who has displayed much ingenuity in many of his special applications. It is a wooden, cylindrical commutator upon which are fastened lugs, which act upon 60 quick-break switches, mounted upon a slate board. The commutator is revolved

FIGS. 1, 2 AND 3. ELECTRIC SCENIC THEATERS IN THE MASONIC TEMPLE, CHICAGO.

by a small Crocker-Wheeler motor, of which many are in use throughout the garden, by means of belting and worm gearing. The apparatus is so designed that changes can readily be made upon it as new combinations suggest themselves. Near this switch is located the board controlling all the current used in the garden and its signs, and which is furnished by the plant located in the basement of the building. About 700 amperes was contracted for, but it has not as yet been necessary to demand that amount. The board, which is made of slate, is a novelty in its way and is but three by six feet. Sixty circuits enter it and are controlled by one main switch, four separate circuit switches and 20 individual switches. Eighty sets of fuse terminals are placed upon it, as well as other instruments. It is but fair to state that all the improvements which it is intended shall make the place a most attractive one have not as yet been made. Much detail is to be added to the theaters and much in the way of popularizing the garden is yet to be done. All the lamps employed are of the Packard type and range from one to 300 candle power. Whether this form of amusement, which is novel, will be successful in drawing paying crowds is a matter for conjecture, but the place is certainly worthy of a visit from those who enjoy beautiful scenic effects without action and a superb view of Chicago from its highest building.

Discriminating Lightning Arresters, and Recent Progress in Means for Protection Against Lightning.

By Alexander Jay Wurts.

PART IV.—NON-ARCING RAILWAY LIGHTNING ARRESTER.

I have, however, designed a lightning arrester which is much smaller, cheaper, and, perhaps, in every way more desirable than the condenser arrester. It is also a discriminating arrester.

I had frequently noticed what is probably familiar to many of you, namely, that a disruptive discharge will leap over a non-conducting surface much more readily than through an equal air space. The non-conducting surface seems to form an entering wedge, as it were, through the air, so that this being already partly split or ruptured, the discharge has but to further separate the air from the non-conducting surface instead of boring its own path through it. A pencil mark over a rough piece of glass or unpolished marble still further reduces the breaking-down strain.

But, to avail myself of this fact in the construction of a lightning arrester was a problem over which I pondered for some time. My design was to bring electrodes located in a discharge surface near enough together to form a lightning arrester spark gap, and at the same time to avoid the passage of dynamo current when the electrodes were connected to the terminals of a 500 volt direct current generator. I reasoned that a dynamo arc to be maintained must be fed by the vapors of its electrodes. To prevent an arc, the formation of such vapors must be suppressed. My first attempt in this direction proved successful. I drew a pencil mark about two inches long over an unpolished piece of marble, covered this with a second piece similar to the first, and, having previously slipped between the two marbles pieces of aluminium foil as terminals to the pencil mark, I bound the whole together with twine. These terminals were now connected to the terminals of a 500 volt direct current generator and disruptive discharges caused to pass between the marbles and over the pencil mark. A one ampere fuse was connected in the dynamo circuit. No current following these discharges, the terminal foils were brought successively nearer together, testing each time for the passage of dynamo current. When the electrodes had reached a distance of a quarter of an inch from each other the fuse was blown. The terminals were now placed a half-inch apart, and oft repeated tests failed to establish a short-circuit. The dynamo was now cut out and upon resting my hand on the upper marble, while the discharges were still passing, I noticed a considerable mechanical shock, and when the twine was removed, the upper block was thrown off. In consequence of this, it seemed advisable to provide more space for the discharge. A small groove was, therefore, cut in the lower marble from one electrode to the other, and well blackened with a lead pencil mark. Discharges now failed to produce the above mentioned mechanical shock, or to throw off the cover. It was, however, noticed that after several discharges had passed, this pencil mark disappeared, having been dissipated and apparently scattered over the surfaces of the two marbles. To overcome this difficulty a piece of wood was laid into the lower marble between the electrodes, and into this a shallow groove was burned. This construction seemed to possess some advantages over the one already described; it suggested most lasting qualities. Various materials were now tested, into which one or more discharge grooves might be burned, such as fiber, felt, leather, ivory, boxwood, celluloid and others, but most of these proved unsatisfactory for various reasons. With fiber, the charred surface was quickly worn away, ivory chipped off in small pieces, both leather and felt crumbled away. Lignum vitæ, however, proved to be a most excellent material. In the final form adopted for this arrester both upper and lower blocks were made of this material, thus enabling the discharge grooves to be burned into the lower block itself, and avoiding the necessity of inserting a discharge piece between the metal electrodes. The blocks are 3 inches wide by 3½ inches long and 1 inch thick. Two brass electrodes, each one inch wide, are laid into the lower block, flush with its surface, the distance between electrodes being ½ inch. The charred grooves are nine in number, and about 1-16 inch wide by 1-32 inch deep.

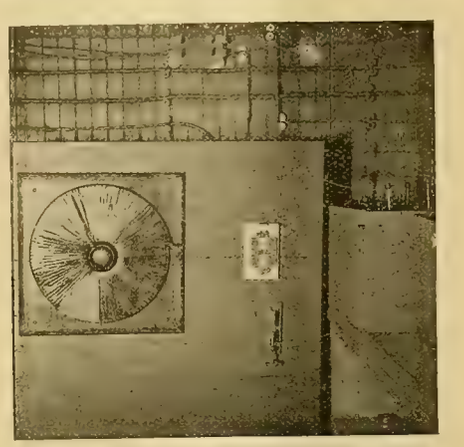


FIG. 23. DISCRIMINATING LIGHTNING ARRESTERS.

Another and more simple form of this arrester was also constructed. A hole was bored through a solid block of marble, the center of which was then filled with a cylindrical block of hard maple having grooves burned in on the sides. Solid brass cylindrical electrodes were then inserted in either end, making a snug fit. But, in practice these marbles were in many cases split open by the expansive force of the discharge, thus demonstrating the necessity of the vent which is obtained by clamping two surfaces together, and between which the discharges may pass.

This device, like the condenser arrester, constitutes a strictly discriminating lightning arrester. In regard to its action I have been asked why a discharge should find an easier passage across a conducting film than through a non-inductive conductor having the same ohmic resistance as the conducting film. My conception of the case is as follows: When a discharge passes through a conductor of more or less ohmic resistance the time of discharge is considerable, there is a great strain from all parts of the charged surfaces during the time of passage, and there will be a tendency to discharge or "side flash" along paths normal to the conductor. The passage of the discharge may be likened to the passage of tangible matter through a dense fluid—there is a gradual yielding of the opposing resistance, but nothing is broken. When, however, a discharge passes over a conducting film as described, there is a sudden breaking down or giving way of the dielectric, and this is aided by the presence of the conducting film. The film, however, does not act in the sense of what is commonly called an electric conductor, but as a wedge, splitting the dielectric preparatory to the passage of the disruptive discharge.

The difference between these two cases is very clearly illustrated by the discharge of a Leyden jar provided with a pith ball electrometer. Take the arrangement shown in Fig. 22; while the machine is charging the battery of jars, the increasing charge can be observed by the deflection of the pith ball, until finally a disruptive discharge takes place across the arrester or spark gap *A*, and the pith ball is seen to fall back suddenly, indicating in this manner complete discharge. If, however, the gap *A* be removed and the discharge be caused to pass either through the inductive coil *C*, or in its stead a non-inductive high ohmic resistance, the pith ball at the moment of discharge will fall part way only, indicating thereby an incomplete discharge. The sound of the discharge in the latter case is also very different from that in the former—it is more like a thud, suggesting opposition to the passage, whereas, in the former case, the sound is that of a crack, indicating something instantaneous and complete.

The non-arcing property of the arrester is easily understood; the conducting vapors which are necessary to the formation and maintenance of a dynamo arc are suppressed by the cover, which fits tightly over the metal electrodes. Supposing a case in which the terminals of the arrester are connected to the terminals of a 500 volt direct current generator. The cover is of glass, so that the discharges may be seen. Five 100 volt lamps in series indicate the dynamo pressure; just below and to the left there is a long horizontal five amperes fuse; to the left of the arrester is a spiral choke coil connected in the dynamo circuit and interposed between the arrester and the generator. This coil is very similar to those which I used in my Colorado experiments. The disruptive discharges immediately below the arrester represent the means used for suddenly charging the dynamo circuit. The discharges across the arrester are distinctly seen through the glass cover. When, however, this cover is removed, the first discharge establishes a short-circuit and the fuse is instantly blown.

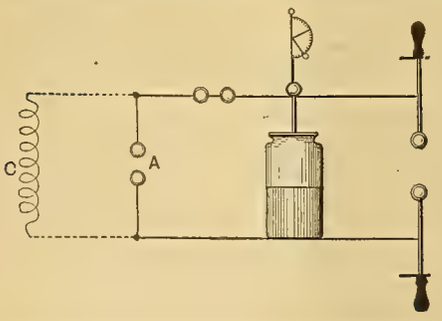


FIG. 22. DISCRIMINATING LIGHTNING ARRESTERS.

Fig. 23 and 24 show the arrangement of the apparatus. *A* is an arrester such as I have been describing and is provided with a clear glass cover so that the discharges may be seen. *C* is a choke coil connected in parallel to *A*; it is 16 inches in diameter and has 17 turns of No. 0 copper wire. Discharges from a battery of Leyden jars invariably pass at *A* in preference to the path *C*, as shown in the photograph.

A thorough test of these arresters has been made in both Denver and Colorado Springs during the past summer. Fig. 25 represents the equipment used in Denver. There were ten feeders, each feeder being provided with three arresters placed three feet apart. These are indicated at 1, 2 and 3. The object of using three arresters to each feeder was to avoid nodal points. *S* represents the circuit-breakers; *T* is a tank arrester; S^1 the discharge circuits of the tank arrester and 4 represents spark gaps in these discharge circuits. None of the arresters were provided with telltale papers, and although they were carefully watched during thunder storms no indications were observed of passing discharges. After the first storm following their installation the writer removed the covers of the upper ten, and of these six showed marks of discharge; the remaining twenty were constructed on the "solid marble" pattern and were consequently difficult and unsatisfactory to inspect.

The only mishap which occurred to any of these arresters was the explosion of one of the "solid marble" type. No experimental line arresters of this type were used on the Denver plant, In Colorado Springs, however, 25 were installed on the line and 24 in the station. Some of these were of the divided kind, others of the solid marble pattern. Nearly all of the latter were split open by the discharges, while of the former none was damaged in the slightest degree. One of the line arresters was provided with three connections to one feeder, with a spark gap and telltale paper in each discharge circuit. This arrangement is shown in Fig. 26. The connections to the feeder were made about two feet apart. After thunder storms each telltale paper was found to be perforated, but whether the discharges occurred simultaneously or successively is not known. The perforations shown in Fig. 27 were taken from this arrester.

This non-arcing railway lightning arrester is eminently suited for the protection of direct current circuits up to 1,000 volts. On 1,000 volt alternating current circuits from smooth body armatures it also operates satisfactorily, but on similar circuits from toothed body armatures the arresters break down after a few discharges, and a short-circuit is established. However, it is not impossible that two or three of these arresters might be used to good advantage in series on circuits of high potential.

These especial advantages of this arrester may now be summed up as follows:

1. It offers a direct and non-inductive path to earth.
2. It is absolutely non-arcing and consequently requires no attention after being once properly installed.
3. It has no moving parts and there is nothing about it to get of order.
4. It is small and therefore easily installed under a car.
5. It is cheap and can therefore be used in large numbers on the line, on the cars and in the station.
6. Its non-arcing property avoids danger from fire, which property also insures the non-interruption of the system due to blowing of fuses and constant throwing of the circuit-breakers.
7. Its simplicity and reliability will commend it to every one.

In my closing remarks I wish to answer the now old and oft repeated question: "How many, and what kind of arresters would you advise us to use on our line?" as follows: The proper number of line arresters is that number which will prevent discharges from entering the station. Station arresters, if used at all, should be installed with the one idea of providing a final opportunity for discharge, but as the tendency to discharge occurs on the line, often several miles away from the station, a sufficient opportunity should be provided there where the tendency to discharge originates, and in this manner advantage may be taken of the large inductive resistance afforded by the circuits leading back to the station. If discharges enter the station it is a sure indication that they have done so for lack of sufficient opportunity to discharge from the line—for lack of a sufficient number of line arresters.

It is well to protect dynamos with lightning arresters—it is better to avoid the necessity of this protection by discharging the line.

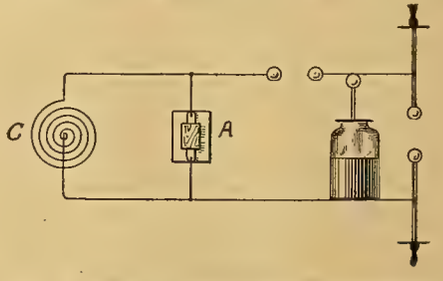


FIG 24. DISCRIMINATING LIGHTNING ARRESTERS.

It is even well to use a lightning arrester having a circuit interrupting attachment. It is better to avoid the necessity of a circuit interrupting attachment by using a non-arcing arrester. In fact, "An ounce of prevention is always better than a pound of cure.

An Optical Phase Indicator and Synchronizer.[1]

By George S. Moler and Frederick Bedell.

In starting a synchronous alternating current motor it is usual to bring the motor up to speed by some external means and to switch it into connection with the generator when the motor and generator are running synchronously, but are in opposite phase. Various devices have been employed to indicate synchronism and to show when the motor is in opposite phase to the generator, one of the simplest of these devices consisting of an incandescent lamp used as a pilot lamp. The lamp is connected directly in the circuit supplying the motor, so that all the current through the motor armature passes through it. Before the motor is started the lamp glows steadily. As the motor attains considerable speed, the lamp suddenly flashes up and dies out alternately, according to whether the electromotive force generated by the motor and the electromotive force from the alternator are in the same or in opposite phases. Beats are thus produced which occur at longer intervals as the motor approaches synchronism with the al ernator. When the intervals are long enough to be quite marked, the motor is connected directly to the generator circuit by cutting the lamp out at a moment when it is dark, indicating that the machines are in opposite phase. At the same time the external power, which has driven the motor to synchronism, is removed. Instead of one lamp, several lamps or a lamp together with dead resistance may be used where required.

This device is simple and efficient. It does not, however, indicate the moment when exact synchronism is reached, nor does it show whether the motor is running at a greater or less speed than that corresponding to the generator. It does not show the exact phase difference be-

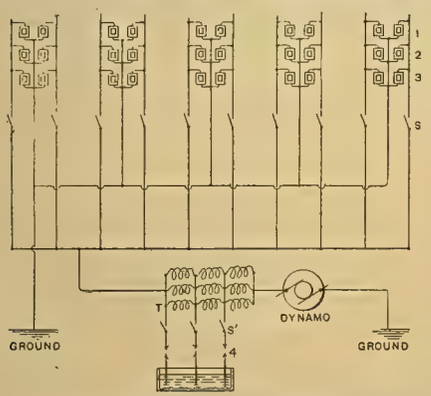


FIG. 25. DISCRIMINATING LIGHTNING ARRESTERS.

tween the motor and generator, and does not indicate the phase relations after the motor has been connected to the alternator and is being driven by it.

The following instrument has been devised by the writers to give definite information in regard to the relative speeds and phase positions of the motor and generator in laboratory investigation. It shows:

(1) When the machines are synchronous;

(2) Which machine is running the faster when they are not synchronous;

(3) The angle by which the motor lags behind the generator.

We will first describe the simplest form of the phase indicator. The motor and generator are placed together with shafts in line and abutting, but not quite touching. The two machines must have the same number of poles, so that a revolution of the armature of each represents the same number of alternations. The abutting ends of the shafts carry two disks, one connected rigidly with the motor armature, the other similarly connected with the armature of the generator, as shown in Fig. 1. In these disks are curved slits, one slit for each pair of poles of the machines. These slits are shown in Fig. 2 for an eight-pole machine. The two disks are in every way similar, the one being the reverse of the other. The two disks are practically superimposed and together form one disk with four holes, where the slits of one disk cross over the slits of the other. Evidently the distances of these four holes from the center depend upon the relative positions of the two armatures; they move in and out as the armatures shift their relative positions. From the symmetrical arrangement of the slits, if one armature is stationary and the other is moved past two pole pieces or through 90 degrees of arc (corresponding to a complete period of alternation, or 360 degrees of phase), the intersection of the slits will be the same distance from the center as before. The curvature of the slits is such that the distance to or from the center that the intersections of the two sets of slits move is proportional to the change in relative position of the two armatures.

When the two armatures are running at the same speed in the same direction and there is a source of light on one side of the disk, the intersection of the slits, as seen from the other side, appears as a continuous ring of light. A slight difference of speed causes this ring of light to move outward or inward, according to which disk is revolving the faster. The more rapidly the ring moves in or out, the greater the difference in speed of the two disks. If the ring is moving out, a new ring starts at the center when one ring reaches the edges, and these rings keep following one another outward. If the difference in speed is the other way, the successive rings move inward.

In Fig. 3 the heavy dotted line represents the ring of light for a particular position of the two disks. The position of the ring of light indicates the relative position of the two armatures. The disks may be secured to the shafts, so that when the armatures are in the same positions with reference to the pole pieces (i. e., the machines are in the same phase), the ring of light will be at the inner or outer ends of the slits. The concentric rings in Fig. 3 represent the phase differences corresponding to positions of the ring of light in this case.

For convenience in operation the arrangement of the apparatus, which has thus far proved satisfactory, has been as follows: On one side of the pair of disks is

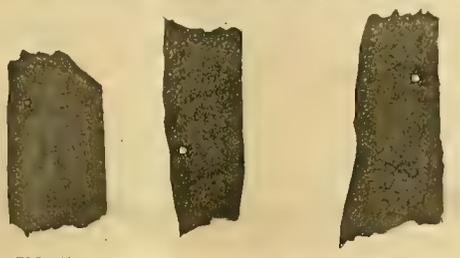


FIG 27. DISCRIMINATING LIGHTNING ARRESTERS.

placed an incandescent lamp enclosed in a box. One side of the box is close to the disk and has a slit in it about half an inch wide, extending from the shaft to the circumference of the disk. This slit is covered with a piece of oiled paper, so as to give a diffused light upon the disk. A complete ring of light is no longer seen from the other side, but only a small portion, corresponding to the width of the half inch slit. A stationary scale is fixed so as to extend from the shaft to the edge of the disks on the opposite side from the lamps, so that the distance of the changing line of light from the center may be read so as to give the phase difference of the two machines by direct reading. To enable one to see the scale and line of light most conveniently, a mirror is arranged at 45 degrees with the disks, so that the line of sight is at right angles to the shaft.

The disks may be arranged in the manner just described upon the abutting ends of the motor and generator shafts only in case the two machines have the same number of poles. Where such is not the case, one or both of the disks can be driven by gears, which will give the proper relative speeds of the two disks.

In operation, the instrument has proved quite satisfactory, giving exact and definite information concerning the changes in the armature lag of the motor. The fluctuations in this lag are usually quite marked, and the conditions which cause them can be readily investigated by this apparatus. For instance, this fluctuation is small with proper field excitation; as the field current of the motor is diminished, this fluctuation increases, the line of light moving rapidly back and forth through a greater and greater distance, which finally becomes so great as the excitation is weakened that it goes a distance beyond which it cannot recover; i. e., the motor gets out of step and

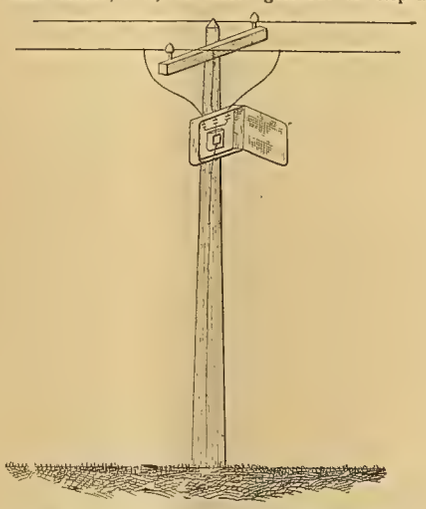


FIG. 26. DISCRIMINATING LIGHTNING ARRESTERS.

stops. It would be possible to make a more detailed investigation of these fluctuations by means of a revolving mirror, and they may be photographed and made of permanent record by means of a moving plate.

The apparatus can be applied to other lines of work involving an investigation of phase differences and synchronism, and may be modified to meet the requirements of the problem in hand; but it is peculiarly suited for use in synchronous motor work, for which it was designed. The scope of the present paper admits only of a general description of the apparatus here given.

1. Read before the American Institute of Electrical Engineers at [illegible], 1894.

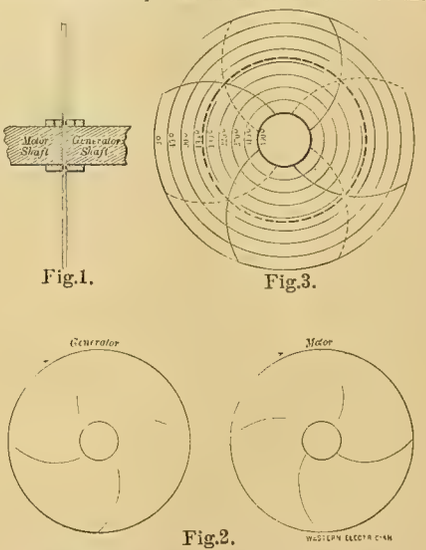
New Telephone Company.

Articles of incorporation were issued at Springfield, May 28th, to the Groff Telephone company, the capital stock being fixed at $1,000,000. The incorporators and stockholders are Lucian C. Pottiger and Calvin Reem of Pennsylvania, and J. F. Tabor, William Bussell and W. F. Bigelow of Chicago. It is not the purpose of the company to establish any manufactory here, it is reported, but to confine its operations to the sale of the Groff telephone and the establishment and management of exchanges in small towns.

Unipolar Dynamos for Electric Light and Power.[1]

By F. B. Crocker and C. H. Parmly.

The object of the present paper is to call attention to the fact that unipolar dynamos and motors are much more practical and generally applicable than is ordinarily supposed to be the case. The term unipolar dynamo is here used in its ordinary sense to designate a machine in which electric currents are generated by the continuous cutting of lines of force. These machines are identical in principle with the original disk machine of Faraday. The term unipolar is by no means satisfactory, but is almost universally used in connection with machines in which the magnetism in the armature is not reversed by the rotation of the latter. In this broad sense, however, it is also used to include machines of the Mordey and other types in which the lines of force always pass through the armature in the same direction; but in these machines there are separate pole-pieces and the lines of force vary in the armature just the same as in the ordinary bipolar and multipolar types. Moreover, machines of this kind usually have their armatures wound with many turns of wire they require a commutator in order to generate direct currents, and are radically different in principle from the continuous cutting machines which are the subject of this paper.[2] The term "non-polar," suggested by Forbes, is preferable to unipolar, but it is rather meaningless and is liable to be understood to mean any kind of iron-clad machine. Unipolar dynamos are also called disk or tube machines, since the armature is usually made in one or the other of these



AN OPTICAL PHASE INDICATOR AND SYNCHRONIZER.

forms. Neither of these terms, however, covers the other, and they are liable to be confused with other types of machine, similar in form but different in principle. The authors suggest continuous pole dynamo as a good name for this type of generator.

HISTORICAL NOTES.

The first machine of the unipolar type was Barlow's wheel, described by him in 1823 and consisting of a star shaped disk with long points revolving between the poles of the magnet. A current was passed through the particular portions of the disk between the poles of the magnet, and the disk was thereby caused to rotate. This apparatus was therefore the first unipolar motor. Faraday's disk machine, constructed and described by him in 1831, was the prototype of the dynamo and was also a unipolar machine.[3] He also made an apparatus working upon the same principle but consisting of a copper cylinder suspended over and revolving around the pole of a bar magnet. This was the first form of tube dynamo.[4] Farady even at that early time appreciated the difficulty of obtaining a sufficiently high electromotive force from generators of this type and attempted to accomplish it by having several disks placed side by side and revolving in opposite directions. Similar ideas have been re-invented time after time, and even at present it is a favorite field for invention. For many years after Faraday's discoveries the unipolar machine was almost neglected, progress being in the direction of machines having many turns of wire in the armature to obtain a high electromotive force. In 1878 Siemens constructed a unipolar machine with a tube armature of considerable size for actual commercial use in electro-metallurgy. Delafield showed at the Philadelphia electrical exhibition of 1884 two unipolar dynamos of the tube type which generated currents of few volts and a large number of amperes. Forbes has also constructed and described unipolar machines, in which the armature is in the form of a cylinder of iron revolving within a field magnet which completely surrounds it. The mechanical and magnetic design of

1. A paper read before the American Institute of Electrical Engineers at Philadelphia, May 16, 1894.

2. The term unipolar is also applied to the Ball dynamo, but this also acts like an ordinary bipolar machine, except that the magnetic circuit is completed through the air and it is in no sense a "continuous cutting" machine.

3. "Experimental Researches," Vol. 1, Art. 85.

4. Loc. Cit., Art. 219.

this machine is very ingenious, and from the practical standpoint it was a considerable improvement upon anything which preceded it. The highest electromotive force obtained from these machines appears to have been about 6 volts, and nothing further has been heard concerning them for several years. The complete neglect into which this type of dynamo has now fallen is best proved by the fact that no example of them was shown at the Chicago exposition. In fact it might be said that their present importance is actually negative since the only attention which has been given to them lately consists of a few articles on "unipolar dynamos which do not work" that have appeared in the electrical journals during the last few months.

GENERAL PRINCIPLES.

The action of unipolar dynamos is based upon the fact that a conductor moving in a magnetic field so as to cut

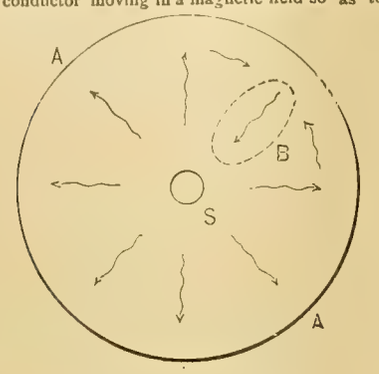


FIG. 1. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER.

lines of force will have an electromotive force set up in it whether the field be uniform in intensity or variable. The error is very commonly made of supposing a variation in the number or density of the lines of force is necessary in order to produce a current by magneto-electric induction. As a matter of fact, however, an electromotive force must always be produced if any lines of force whatever are cut. It may happen, and in the case of a coil of wire it usually does happen, that lines of force are cut in one direction by one portion of the conductor and in the opposite direction by the other portion, in which case one effect neutralizes the other. The simplest example of this is a closed metallic ring moving in a uniform field perpendicular to the lines of force. In this case one-half of the ring generates an electromotive force in one direction and the other half in the opposite direction, so that no currunt is produced; but the full difference of potential corresponding to the number of lines cut per second will, nevertheless, exist between the two sides of the ring.

In the unipolar dynamo or motor a variation in the lines of force is not only unnecessary, but is positively objectionable, since it would cause serious losses from eddy currents and hysteresis, whereas, if the field is perfectly uniform, these losses are practically avoided.

Any break or weakening of the intensity of the field, due to "blow holes" in the casting, for example, would allow the armature current to flow back at that point, and would act as a sort of short circuit on the rest of the armature. For example, in Fig. 1 let A A represent a disk armature revolving upon a shaft S. The field is of uniform intensity, and an equal electromotive force is generated at each radius, as indicated by the arrows, except that the portion B of the armature is in a weaker field. In this case the current will flow back through the portion B, as indicated by the arrow, and the armature will be like a short-circuited one of the ordinary kind. This back current will flow and produce heating and loss of energy, even though the external circuit be open.

It is also a common error in regard to unipolar machines to suppose that the armature cannot be made of iron. As a matter of fact, iron or steel is usually better than copper, because it is a much better conductor of magnetism, and the reluctance of the magnetic circuit can be reduced far below what is possible with a copper armature, the only air gaps being the small mechanical clearances required for free rotation. A steel or wrought iron armature is much stronger than one of copper, not only on account of its greater strength for the same thickness, but also because it can be made much thicker without causing any appreciable increase in the reluctance of the magnetic circuit, whereas a coppor armature would have to be made very thin. The greater specific resistance of iron is not objectionable, since an armature composed of it would have a current capacity far greater than is required, and the thickness can be increased to make up for the higher specific resistance.

METHODS OF MULTIPLYING THE ELECTROMOTIVE FORCE.

The plan suggested by Faraday was to have two or more disks side by side revolving in opposite directions, the edges being connected together by mercury or other contacts, so that the current flows outward from the center of the periphery in one disk, inward in the next disk, and so on in series. In this way it is possible to multiply the voltage as many times as there are disks; but there are obvious mechanical difficulties in rotating these disks in opposite directions, and the numerous electrical contacts would be decidedly objectionable. Hundreds of modifications of this idea have been suggested. For example, Siemens, in the tube machine already referred to, multiplied the electromotive force by splitting the tube longitudinally and placing rings on the end of the tube, so that the current was carried first through one section of the tube, then through another, and so on. In this way the circuit may be threaded through the magnetic field a number of times, each time a certain electromotive force being added. Another plan to accomplish the same result would be to have a number of thin tubes placed concentrically one within the other, but separated by a layer of insulating material, and connected so that the current passes first through one tube, is then carried around outside of the machine and is passed through another tube, and so on through all of them in series.

There is no theoretical limit to multiplying the voltage by some such method, but practically any of these constructions would have very serious, if not fatal, mechanical and electrical difficulties. It would seem to be far preferable to construct the machine of sufficient size and run it at sufficient velocity to get the required voltage without complicating the construction. There is no objection, however, to connecting two unipolar machines in series, both being driven, for example, by one engine, which may be belted or direct coupled, and there is no serious complication involved in operating four or even more machines in series. The first cost and attendance required would probably be much less with four unipolar machines than with one direct current machine of the ordinary type.

One very convenient way to multiply the voltage of a dynamo would be to charge a number of storage batteries by means of a low voltage machine of say 10 or 20 volts. When charged these batteries could be connected in series to give any desired electromotive force, 115 or 230 volts for example, and the actual working current would be supplied by them. The charging could be done at hours when the current was not required, or two batteries could be used alternately to give an uninterrupted supply of current. In this way two advantages could be realized—first, the cheapness and simplicity of the unipolar dynamo, and second, the uniformity of load with which the engine and dynamo could be run.

PRACTICAL DESIGN.

It is not difficult to get up complicated puzz'es in connection with peculiar forms of unipolar machines, but in the simple and probably the only practical forms, we have a single straight conductor which cuts all the lines of the magnetic field once per revolution. In the case of the disk machine, we can consider any radius of the disk as

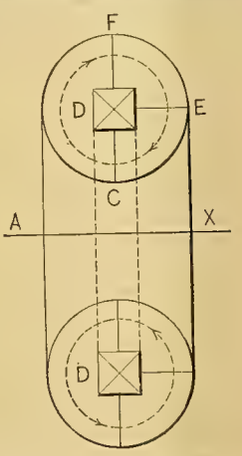


FIG 2. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER.

constituting the conductor, and in the case of the tube machine it is any element of the cylinder.

The theory of the magnetic circuit is now well understood, and modern practice in the design of dynamos and motors fully appreciates the advantages which result from making the ratio between the length of the magnetic circuit and its cross-section a minimum. In a unipolar dynamo this reduction of the reluctance of the circuit can be carried further than in any other class of machines, because the creation of an electromotive force by the continuous cutting of the lines of force enables a form of magnetic circuit to be employed which in the highest degree combines the advantages of minimum length with maximum cross-section. This type of magnetic circuit is the circular ring; for if we surround a circular coil, D D, of wire, carrying a current, with two circular rings of semicircular cross-section, as shown in Fig. 2, we shall form a closed magnetic circuit of maximum induction for minimum excitation. Cut this circuit along any radius of the circular cross-section and a magnetic field is obtained, in which, if an inductor be rotated about A X as an axis, there will result a continuous cutting of the lines of force, which only requires that appropriate collectors be provided to form a closed electrical circuit, in order to produce a current of electricity. The magnetic circuit is indicated by dotted circles with arrow heads.

There are, however, but two directions in which the magnetic circuit can be cut so as to form a field suitable for practical use. One is along the radius C D, in which case the inductor will rotate in a plane pendicular to the axis, and the other is along the radius E D, in which case the inductor will move in the convex surface of a cylinder whose axis is the axis of rotation. In the first case the armature of the resulting dynamo will be a disk, and in the second case a cylinder. In both, the way to collect the current would be to provide one set of collectors at the center of the circular cross-section and the other set at the axis, thus utilizing the shaft as a portion of the electrical circuit. The relative advantages and disadvantages of the two forms depend upon circumstances in each particular instance.

In many instances the single magnetic circuit shown in Fig. 2 is not the best for practical use, because it would be necessary to make the diameter of the ring larger than it would be if two rings were placed side by side as shown in Fig. 3 and Fig. 7, because in this type of dynamo we must depend wholly upon the total magnetic induction and the speed of rotation to produce the electromotive force, as it does not appear to be practicable to greatly multiply the voltage by multiplying the number of inductors.

Another consideration of importance is the volume of the ring. It is evident that any required area of pole surface can be provided by keeping the mean diameter of the ring constant and varying the radius of the circular cross-section between certain limits, or by keeping this radius constant and varying the mean diameter of the whole ring. It is also evident that for any particular required area of pole surface any decrease in the mean diameter of the ring requires a corresponding increase in the radius of the circular cross-section and vice versa. In Fig. 4 let the circle whose radius is r and the distance of whose center from the axis of X is b revolve about that axis generating a volume of revolution. This volume forms the field magnet and contains nearly all the weight and a large part of the cost of the machine. This volume, which is an annulus, may be determined by the centrobaric method, according to which a volume of revolution is equal to the generating area multiplied by the circumference described by its center of gravity. Hence the volume:

$$V = 2\pi^2 r^2 b \qquad (1)$$

The factors r and b must have certain values in order to produce the required electromotive force, the latter being usually the definite object for which a dynamo is designed. The values of r and b are found as follows:

Let E = the required electromotive force expressed in volts.

Let n = the number of revolutions per minute.

Let B = the number of magnetic lines per square inch.

Let A = the number of square inches of pole surface.

Let r = the radius of the circular cross-section of the ring expressed in inches.

Then because the two rings are wound so that the electromotive force due to the field of one is added to that due to the other, each ring must be designed to provide enough lines to generate only $\frac{E}{2}$ volts. This requires that $\frac{E}{2} \times 10^8$ lines must be cut per second, or $\frac{E}{2} \times 10^8 \div \frac{n}{60}$ per revolution. Hence the number of square inches of pole surface needed is

$$A = \frac{30 E \times 10^8}{n B} \qquad (2)$$

As shown in Fig. 3, the core of the ring will be utilized for the exciting coil, and for simplicity of construction we shall make its cross-section square. It is desirable to keep the size of this square as small as possible, because any increase in the length of a side increases the diameter of the circular cross-section an equal amount, and therefore enormously increases the volume, which is proportional to the second power of the diameter. But this square cannot in practice be made indefinitely small, because too great a concentration of the lines immediately surrounding the coil must be avoided, and space enough provided to give ample excitation. One-half of the radius appears to be a length suitable for the side of this square. Referring to Fig. 5 we shall then have an area of pole surface

$$A = 2\pi b \tfrac{3}{4} r. \qquad (3)$$

But we have seen in equation (2) that we need an area equal to

$$\frac{30 E \times 10^8}{n B}$$

hence equating this with the above value of A, we have

$$2\pi b \tfrac{3}{4} r = \frac{30 E \times 10^8}{n B}$$

The ratio between b and r which seems to best fulfill the

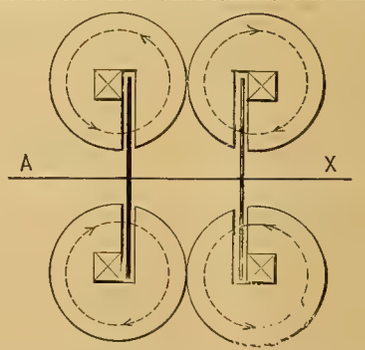


FIG. 3. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER.

conditions of good design is $b = 2.5r$. Making this substitution above and designing so that $2b$ equals the outer diameter D of the armature, we have

$$D = 10^5 \sqrt{\frac{2E}{\pi n B}} \qquad (4)$$

which shows that the dimensions of the machine are directly proportional to the square root of the required electromotive force, and reciprocally proportional to the square roots of the speed and of the magnetic induction. It is to be further observed that since for machines varying widely in their outputs B is nearly constant, the most important ratio in equation (4) is $\frac{E}{n}$.

In the design of a machine for any special voltage, however, E is fixed, and therefore the only arbitrary quantity is n; so that the whole problem is to determine the values of D and n which give the best design.

Let v = the peripheral speed in feet per second; then we have

$$v=\frac{\pi n D}{720}$$

whence

$$Dn=\frac{720\,v}{\pi} \qquad (5)$$

Substituting in this equation the value of D given by equation (4) we have

$$v=0.000000825\frac{v^2 B}{E} \qquad (6)$$

and

$$D=\frac{10^9}{36}\frac{E}{vB} \qquad (7)$$

from which the values of D and n can be immediately determined for any prescribed values of E, B and v.

The maximum velocity in feet per second which the rim of a fly-wheel may with safety attain is given by the equation[5]

$$v=3\sqrt{t}$$

where t is the safe stress of the metal in pounds per square inch. If the inductor be of wrought iron or of steel for which t=10,000, we shall have v=300; and if of cast iron for which t=5,000, we shall have v=210 nearly. The much higher permeability of cast steel over cast iron, and its comparatively small additional cost make it the metal most economical to use, and we shall therefore assume that the inductor is either of wrought iron or of cast or forged steel. Hence, making v=300 in equation (5) we find that the maximum value which the product Dn can obtain is Dn =68,750. This then is a condition which must not be exceeded in order that the design shall be mechanically safe. Making v=300 in equations (6) and (7) we have

$$n=.7425\frac{B}{E} \qquad (8)$$

and

$$D=\frac{10^7}{108}\frac{E}{B} \qquad (9)$$

If the armature were made of forged steel it would be allowed to assume t to be as high as 20,000 since the armature is entirely enclosed and could do no harm even if it burst. In this case v=423.

We have now to deduce a formula for the number of ampere turns required to produce the necessary excitation. As a first approximation

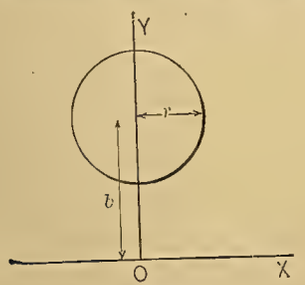


FIG. 4. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER.

and to enable us to determine the general conditions, the cross-section of the ring was assumed circular. In practice, however, this form of section must be modified, for a reference to Fig. 2 shows that, in order to give the same area of cross-section perpendicular to the direction of the lines of force at $D\ C$ and $D\ F$ as at $D\ E$, we must cause the circular cross-section to bulge out on the side toward the axis and contract on the side away from the axis.

On account of the diminution of cross-section due to the air gap and to the holes for the brushes, it is found necessary, however, to preserve for the outer portion of the ring a semi-circular cross-section, and it ultimately assumes the form shown in Fig. 6.

The mean length of the magnetic circuit is therefore the length of the semi-circle $a\ b\ c$ plus the length of the curve $a\ d\ c$. Assuming the air gap to be .06 $\sqrt{D}$, we have the data for determining the ampere turns required.

The amount of current which the dynamo can generate is determined by the carrying capacity of the armature and brushes. Since .2 $\sqrt{D}$ may be assumed to be the thickness of the inductor, we have for the current carrying cross-section of the armature .2 $\pi D^{\frac{3}{2}}$ square inches. Since iron or steel would carry at least 200 amperes per square inch, the current capacity of the armature is C=40 $\pi D^{\frac{3}{2}}$ (10) which at E volts gives the capacity of the machine in watts

$$W=40\pi D^{\frac{3}{2}} E \qquad (11)$$

To show the application of these formulæ to two widely different classes of machines, let it be required:

First. To design a belt-connected dynamo to generate 10 volts at 1,200 revolutions per minute for electro-metallurgical purposes. Making field magnets and armature all of cast steel and taking the induction B at 90,000 lines per square inch we have from equation (4) D=24.28= diameter armature in inches.

Second. To design a direct-connected dynamo to generate 130 volts at 200 revolutions per minute for light and power purposes. As before we have

$$D=214.4.$$

These figures show the immense possibilities of the unipolar dynamo, possibilities so immense indeed that the practical difficulty is not in the design of the dynamo, but in the design of the steam engine. Two machines like the last coupled at the ends of the shaft of a 100,000 horse power engine would supply more current than is at present consumed in any two cities in the world. Nor is the excessive current a disadvantage, for while we would point out the tremendous capacity of one of these dynamos, there is no necessity for running them at their maximum output. Even if we diminished the current to one-hundredth its ultimate value and only use a 1,000 horse power engine to drive the dynamo, the loss due to the resistance of the armature will still be only four or five per cent.

A more economical way of supplying current for light and power, however, would be to design unipolar dynamos of less current carrying capacity and less voltage, and then join in series on the same shaft as many as are needed to produce the required electromotive force. For example, we may generate 130 volts by joining in series on the same belt driven shaft two dynamos each giving 65 volts at 800 revolutions per minute.

The dimensions will be as follows:

$$D=75.81.$$

Running this combination at one-tenth of its ultimate

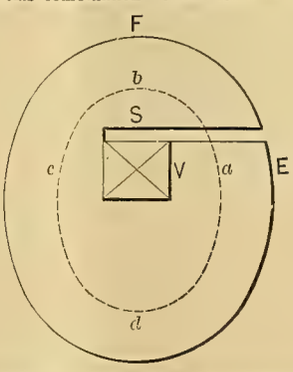


FIG. 6. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER.

capacity by means of a 1,250 horse power engine, we should still have a very high efficiency.

Methods of Taking Off the Current.—The best means of making electrical connection with the revolving armature is a very important but somewhat difficult matter. A great many devices have been tried or suggested. The principal of these are brushes of copper gauze or carbon, and mercury contacts applied to the edges of the disk or tube. Belts or straps made of flexible sheet copper or copper wire cable have also been used. One application of this latter device consists in connecting together two armatures by such a belt, whereby the electromotive forces of the two machines are added together, and, if necessary, the mechanical power for driving one or both machines can be transmitted by this same belt. There would not seem to be any great difficulty in applying brushes to a unipolar dynamo; in fact, for a given current it would seem to be a much easier problem than with a direct current machine having a commutator, since the former has a continuous and smooth bearing surface for the brushes instead of the somewhat uneven surface of copper and mica which exists on a commutator. It is a fact that the speed may be very high, but with the perfectly smooth surface and by the use of brushes with light pressure and composed wholly or partly of graphite, or some friction metal, which might even be lubricated, it would appear to be possible to take off a current sufficient for almost any electric light or power use. If the very high speed makes the friction too great to permit of the use of brushes, the edge of the tube or disc may be arranged to run in a mercury trough, thereby making a good electrical contact with very little friction. In this case, however, pro-

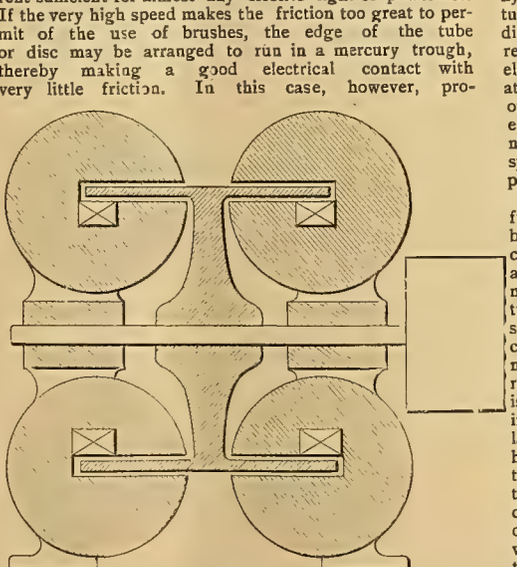


FIG. 7. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER.

vision should be made to prevent the mercury from being thrown off by centrifugal force, as by the use of a guard ring extending all around the edge of the tube or disk. Another device would consist of ball bearings applied to the shaft or to the periphery of the disk or cylinder. These might perform their ordinary mechanical function and also serve to take off the current.

Method of Driving.—There are various mechanical arrangements available for connecting a unipolar dynamo to the source of power. The simplest would be to connect the dynamo to the engine by means of ordinary leather belting, either with or without the use of a countershaft. In this way a high speed can easily be obtained if desired and is perfectly permissible since the solid disc or tube of steel which constitutes the armature is capable of a much higher speed of rotation than the ordinary built-up form of armature now used. It would probably be safe to have a solid steel armature run at two to four times the speed of the ordinary armature having the same diameter.

If the dynamo be directly coupled to the engine the speed of the latter and the diameter of the armature may be most economically proportioned to give any desired voltage by the application of the previous equations.

An arrangement which seems to possess great advantages would consist of a steam turbine running at 10,000 or 20,000 revolutions per minute, which is the ordinary speed of such machines, directly coupled to a unipolar dynamo. These two machines seem to be admirably suited to each other, the very high speed of the turbine compensating for the fact that there is but one inductor. This combination entirely avoids the necessity for reducing the speed of the engine by gearing, which is done in the case of the Laval turbine, or the risk which is involved in running a wire wound armature and sectional commutator at a speed of 10,000 or more revolutions per minute, which is the plan adopted with the Parsons turbine.

Advantages of Unipolar Dynamos and Motors.—The greatest advantage of the unipolar machine is its extreme simplicity. Its armature consists of nothing but a solid cylinder or disk of steel, or other suitable metal firmly mounted upon a shaft. We have only to compare this construction with that of the ordinary armature consisting of hundreds of pieces of sheet iron, bolted or otherwise held together to form the armature core, and wound with a great many turns of wire or bars of copper which have to be thoroughly insulated from each other, and which are not very securely held in place. In addition to this we have the commutator consisting of 50 or more sections of copper separated by strips of mica and held together by nuts, etc. The electrical connections between the armature and commutator also add to the complication. In short it would be difficult to find any two pieces of machinery in which the contrast between simplicity and complication is greater. The construction of the field magnet and the rest of the machine is also very simple. The elimination of the commutator, although already mentioned in connection with simplicity, is nevertheless an essential feature of this type of machine and is a great advantage. The almost infinitesimal armature resistance of these machines is decidedly advantageous, not only in increasing efficiency and decreasing heating, but also because it causes the machine to regulate more closely,

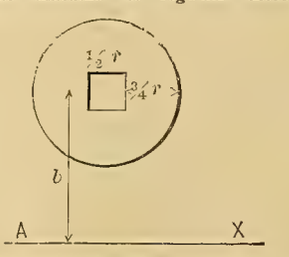


FIG. 5. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER.

either as a dynamo or as a motor. According to all accepted theories there would be no hysteresis in these machines, because both the armature and field are always magnetized in exactly the same direction and to exactly the same intensity.[7] For similar reasons there would be no foucault currents, since the electromotive force generated in any element of the armature would be exactly equal to that generated in any other element and there could be no tendency to produce eddying currents. This perfect uniformity of the magnetic field is secured by the construction which is exactly symmetrical, the air gap being precisely the same at all points.

The question of armature reaction is somewhat doubtful since some authorities state that it is quite considerable, but in the opinion of the authors it is very small, and certainly no greater than in other types of machine. The armature consists of only a single turn, consequently the maximum magnetizing effect of the armature in ampere-turns is numerically equal to its current capacity, and since the ampere-turns on the field would be made considerably greater than this, the armature reaction cannot be great. It is interesting to consider how armature reaction can occur in such a machine. The probability is that it has the effect of curving and slightly lengthening the lines of force so that they do not pass perpendicularly from one pole surface to the other in the air gap and have a spiral path in the iron, since the field current tends to produce lines in planes, passing through the axis, and the armature current acts at right angles, producing an inclined resultant. There can of course be no change of distribution of magnetism as a result of armature reaction, which is really the objectionable effect that it produces in the present types of machines, and in the unipolar machines there are no back ampere-turns and no magnetic leakage.

In conclusion we may say that unipolar machines are practically indestructible, since they are so simple and so strong that they are not likely to be damaged mechanically, and it is almost impossible to conceive of one being burnt out or otherwise injured electrically, since the engine would be stalled by the enormous current before the armature could be fused by it. A machine possessing all these important advantages certainly deserves a prominent place in electrical engineering, whereas it now has practically no existence whatever.

5. Thurston, "Manual of the Steam Engine," Part II., Art III., p. 422.

7. There might be some molecular friction due to cutting the lines of force, but this would probably be slight.

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ACCORDING to the London *Electrical Review* a loud-speaking telephone has been devised by Mr. Graham, which, it claims, "will create a real sensation and ought to revolutionize the present systems of working." The same authority says that the receiving portion of the apparatus has the merit of being so powerfully responsive to the electric current that the voice of a person speaking to the apparatus at one end of the line, in ordinary tones, can be heard distinctly in all parts of a room at the other end, and this without the listener or listeners having to place the receivers to the ear or to move from their seats. There are no bells required, the loudness with which the voice is reproduced being quite sufficient to call attention at either end. In connection with this loud-speaking instrument a system has been devised by which any room in a building may be placed in direct communication with any other room; the only additional apparatus necessary to accomplish this being a switch, thus doing away with the complex apparatus and exchange systems at present in use. Our English contemporary commends the new apparatus highly. It says "they are no laboratory instruments," but are fitted for everyday commercial work. It does not, however, anticipate their general adoption in exchange work, but believes that they will find an excellent field in private lines and factories.

SEVERAL really meritorious publications have been issued recently by the electrical engineering departments of the leading educational institutions of the country. As a rule they contain papers prepared by students, describing experiments conducted during the year, and are the best possible evidence of the advancement that has been made in the last few years. At the present time nearly every college of any pretension in the country has a department in which elementary lessons in electricity are given and in many special attention is devoted to electrical engineering. Laboratories, equipped with the latest apparatus, are at the disposal of pupils, and in these institutions many important investigations are conducted. It is to the credit of the leading electrical companies of the country that they have encouraged and assisted the work and contributed much toward bringing these institutions up to their present high standing.

RECENT experiments in the application of electricity to dyeing have been rewarded with results that are very encouraging to investigators in this line, and may lead eventually to still greater improvements. It will be remembered that when Goppelsroeder demonstrated that indigo could be reduced by electrolysis, indigo dyers were not slow to take advantage of the discovery. In the old process the vat would become silted with sediment, and there would be aggravating and prolonged interruption of the work. In the new system it was found that this objectionable feature was obviated, but experience soon showed that there was another objection to be overcome. It was discovered that the prolonged electrolytic treatment of indigo caused a further change in the dye-stuff, resulting eventually in its total destruction. Further experiments were made, however, and the results recently published show that the process is affected by the temperature. In the cold satisfactory results could not be obtained, while at boiling temperature the operation was successfully accomplished.

IN view of the recent action of the Legislature of New York, on the subject of rapid transit for the metropolis, it is interesting to note that there is reason to believe that a similar project will be adopted at Paris, where it is proposed to construct an underground electric railway from the Bois de Boulogne to the Bois de Vincennes. This railway, which it is proposed to build according to the designs of M. Berlier, who has already obtained a concession for its construction, is to form a complement of the metropolitan railway which has been discussed in Paris for many years. It provides for an iron tunnel 20 feet in diameter, and the plans have been approved by experts of the city who have investigated the claims of the inventor. It is reported that M. Jonnart, one of the French ministers, appeared before the French Railway Commission, in company with M. Colson, to furnish particulars regarding the proposed electric railway, and discuss the plans with the municipal engineers, councillors and the promoter, M. Berlier. The opinion of the general council of the Bridges and Ways Department and of the municipal engineers was favorable to the scheme. It remains now for the Chamber of Deputies to approve the project before actual operations are begun.

THE paper on "Alternating Currents and Fuses," read before the Philadelphia meeting of the American Institute of Electrical Engineers, is presented elsewhere in this issue. The results of the experiments conducted at the University of Wisconsin by Mr. Ochsner and reported in this paper are diametrically opposed to those given in Mr. Matthews' paper last year. The investigations described in the latter paper showed considerable rise of resistance and lowering of the fusing points of the fuses placed in alternating circuits, while Mr. Ochsner's tests indicate that such slight changes as did occur were due to oxidization, rather than to the disintegrating effect of the alternating current, and the effect was moreover, too small to be of practical moment. In Mr. Matthews' tests corrections were made for the standard resistance with which the fuses were compared, but no such corrections were made for the fuse wires. The fuses were subjected to larger currents, with consequent greater heating, than in the tests conducted by Mr. Ochsner, who also explains that the resistances were apparently measured without allowing sufficient time for the fuses to acquire the temperature of the room, and even if this were done, the variation in temperature of the room, as given in the original report of the investigation, was sufficient to introduce serious errors. The resistances were measured by the fall of potential method, and no extra resistance was put in series with the battery to reduce the current strength. This current may have been sufficiently great, in the smaller sized fuses, to cause considerable heating. The accuracy of the tables, and, therefore, the conclusions based upon the work reported by Mr. Matthews, are questioned by Mr. Ochsner. Attention is called to the fact that in practice a fuse is seldom obliged to carry a current equal to its full rated capacity. All the lamps protected by a fuse, for instance, are not likely to be turned on at one time. The experiments reported in the paper presented in this issue represent the conditions of ordinary practice, and would, therefore, show that a fuse as used in practice, is not directly affected by the alternating current. This is the conclusion reached by Mr. Ochsner and seems to be in line with the results obtained by English investigators.

THE question of lighting steam railway trains by electricity is an interesting one. Wherever the railroad companies have furnished an efficient service of this character, the traveling public has hailed the electric lights on the cars with great favor. The points of advantage are numerous. The light is steady and pleasing, with no odor or other disagreeable features; no attention on the part of trainmen or porters is required, the simple turning of a switch being sufficient; there is no heat, and the superior cleanliness and convenience in every way are marked. In the case of railroads which run through frequent tunnels, as in mountainous districts, the advantage of being able to turn on a few lights in each car instantly is very obvious. These facts are well recognized by railroad superintendents, who would doubtless be glad to introduce electric lighting on all express passenger trains were they not deterred by a general impression that the expense is too great. Electric train lighting is therefore restricted to a few crack 'flyers" which derive a considerable proportion of their renown from this feature.

Four methods of operation have been tried. In one a complete electric lighting station is carried on the train, with independent boiler and engine carried in one end of a baggage car or in a separate lighting tender. This method has been found very satisfactory in operation, but the cost of the lighting is considerably greater than with compressed gas and far in excess of that for oil lamps. An example of this system is the Chicago-Minneapolis express train of the Chicago, Milwaukee & St. Paul Railroad company, which was described in detail in the WESTERN ELECTRICIAN of February 13, 1892. A second plan is the installation of a dynamo driven by a connection with the car axle and supplemented by storage batteries which are automatically thrown into circuit when the train is at rest or when variations in the speed of the car cause the electromotive force of the dynamo to fall below or rise above the proper voltage. This method has been practiced successfully in England, but has not been adopted in the United States, owing to the fact that bogie trucks are here used almost exclusively in place of the rigid wheel base of Europe, making it difficult to keep the armature shaft parallel to the car axle at all angles of the track. The third system—employed on several Pullman trains—consists in the use of an engine and dynamo in the baggage car, steam being obtained by a flexible connection with the locomotive boiler. This has resulted fairly well in practice, but there is a considerable loss in steam transmission, and it is objected that a disproportionate inroad is made in the steaming capacity of the locomotive, especially in winter weather, when all the power of the locomotive is needed. In consequence of this fact storage batteries are carried, which still further lessens the economy of the system. The last method is the use of storage batteries entirely, the cells being removed from the car and charged at terminal stations. Many experiments have been made in this direction, the latest and perhaps the most promising being on the Chesapeake & Ohio railroad. Here, as in other cases, the principal difficulty was in handling the batteries and changing them in and out of the cars. The cells are heavy and must of necessity be handled with care, so that the services of two men and careful management is necessary with a special hand-truck. It is encouraging to note, however, that the cost of storage battery lighting in this case has so far proved to be about 13 per cent. less than that of Pintsch gas, although this may be changed as the result of further experiments.

Each one of the four plans here outlined has its advocates, and more or less work is being done on each. With the railroad and electrical men combined to obtain a practical result, it cannot be doubted that the electric lighting of railway trains, now slowly spreading, will in time become the accepted method for high-grade passenger service the whole country over.

Alternating Currents and Fuses.[1]

By Prof. Dugald C. Jackson and R. J. Ochsner.

This paper is a report of an investigation made by Mr. Ochsner in the electrical engineering laboratory of the University of Wisconsin. The results are positive and of sufficient practical value to justify consideration. They set at rest all questions regarding the direct effect of the alternating current upon the average commercial fuse wire. Practically speaking, there is no such action. Mr. Ochsner's report is as follows:

The following work was undertaken with a view to studying the disintegrating effect of alternating currents on fuse metals which has been reported, and, if possible ascertaining the cause. As the work done at Cornell University[2] last year showed such a remarkable rise of resistance, and a lowering of the fusing points of the fuses placed on the alternating circuits, I decided to repeat the experiments, and if any change in the resistances should take place to prolong them.

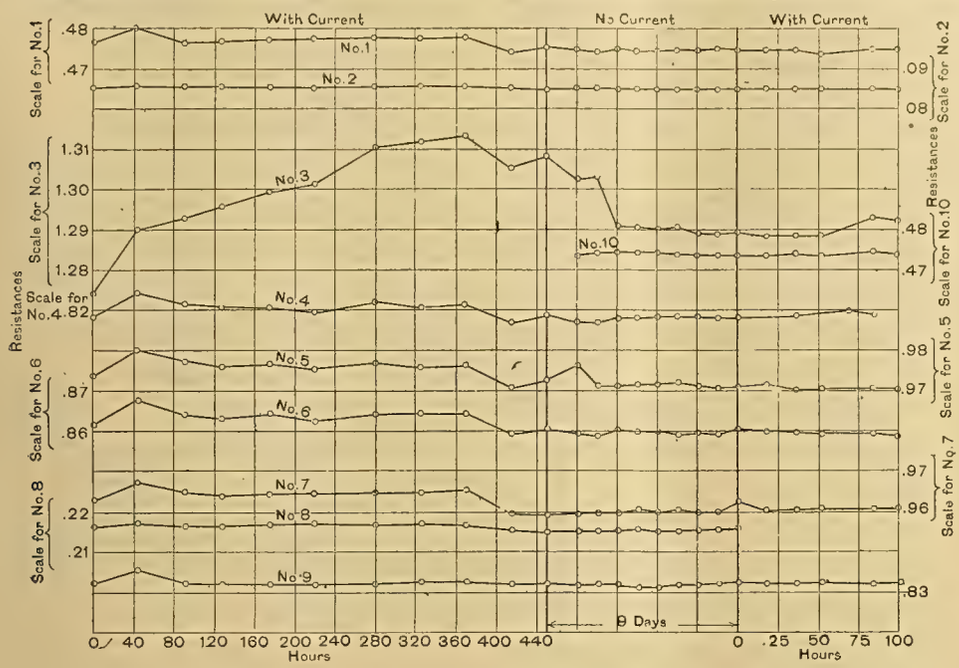


FIG. 1. ALTERNATING CURRENTS AND FUSES.—CHANGES IN RESISTANCE OF FUSE WIRES, SUBJECTED TO THE ACTION OF ALTERNATING CURRENTS.

I.—THE EFFECT OF ALTERNATING CURRENTS ON THE RESISTANCE OF FUSES.

Samples of fuse wire of five amperes rated capacity were obtained from five different manufacturers, and to these were added a 30 ampere fuse wire which we happened to have, and a copper, a german silver, and an iron wire. Pieces of wire from each sample, each of them varying from nine to ten feet in length, were wound upon cylindrical pieces of pine wood about a foot long and one and one-half inches in diameter. The table below gives the names of the firms from which the samples were obtained and their rated capacities:

	Rated Capacity.
Ansonia Electric company (Wirt fuse wire)..	30
Shawmut Fuse Wire company (two samples).....	5
The Independent Electric company.....	5
Peru Electric Manufacturing company.....	5
The E. S. Greeley & Co.....	5
Taylor, Dee & Mack.....	5
Iron wire.....	
German silver wire.....	
Copper wire.....	

To prevent the turns of wire from crowding together on the cylinders, thus causing short-circuits, short, helical grooves were made with a file. To the end of each fuse short pieces of heavy copper wire were soldered, and the joints were wiped with a damp cloth. These terminals were fastened to the wood by light staples and the ends were amalgamated. A simple rack was constructed so that all the fuses could be put in series, the copper terminals dipping into mercury cups.

TABLE I.

No.	t	t_1	R	t'	t'_1	R'	Rise for 1° C.	Coeff.
1	23.2	22.8	.4794	7.26	10	.4505	.00190	.00400
2	"	"	.0858	"	10	.0813	.00304	.00357
3	"	"	1.3025	"	10	1.2354	.00444	.00344
4	"	"	.8273	"	9.9	.7816	.00301	.00368
5	"	"	.9801	"	9.9	.9259	.00357	.00368
6	"	"	.8683	"	9.9	.8209	.00313	.00364
7	"	"	.9701	"	9.9	.9107	.00390	.00406
8	"	"	.2184	"	9.8	.2001	.00119	.00535
9	"	"	.8309	"	9.8	.8302	.00020	.00024
10	"	"	.4792	"	9.8	.4503	.00190	.00401

The resistances were determined by means of the Anthony bridge in the laboratory of the University of Wisconsin, the readings being taken to the fourth decimal place. Connections were made by dipping the copper terminals of the fuses into mercury cups, and using short, heavy copper wires for leads. A dead-beat galvanometer was used, and in this way it was possible to do the work in about twenty minutes. As it was impossible to keep the laboratory at a constant temperature it was necessary to make temperature corrections, and, therefore, to determine the temperature coefficients of all the samples. It was, however, possible to keep the temperature within a few degrees of 20° Centigrade, which I considered the standard temperature, and to which I reduced all my results.

Therefore it was thought sufficiently accurate to determine the coefficients in the following way, a small error in the coefficient introducing only a slight error for a correction of a few degrees. On one occasion the room was allowed to cool to the outdoor temperature and the resistances were measured, and the next day the room was heated as high as possible, and the resistances were again measured. A range of about 16 degrees Centigrade was obtained. The average rise of resistance for ones degree and the coefficients were then calculated.

The bridge has a temperature coil, from the resistance of which the temperature of the bridge coils is quickly found. The temperature coefficient of the bridge coils is only .00023, and, therefore, the corrections for them can be made very accurately. The rise of resistance for one degree Centigrade and the coefficients, together with the data from which they were obtained, are given in Table I., in which t is the higher temperature, t_1 the temperature of the bridge coils, and R the measured resistance corresponding. Similarly the letters marked with a prime correspond to the lower temperature:

The fuses were now put on the alternating lighting circuit which furnishes the light for the laboratory. Enough resistance was put in series to give a current of about three amperes. The pressure is 110 volts, and the frequency, approximately, 125. The lighting circuit is run continuously, except for about nine hours on Sundays; but to have a check on the time that the fuses were subjected to the current a Thomson recording wattmeter was placed in circuit. The resistances of the fuses were measured at fairly regular intervals, and the corrected results were plotted.

The following table is a sample of one measurement. The resistance of the temperature coil was considered to vary uniformly during the test:

No.	Temp.	Resis. Temp. Coil.	Resis. Leads.	Resistance.
1	20.30	267.2	.00322	.4785
2	20.30	"	"	.0883
3	20.35	"	"	1.2950
4	20.35	"	"	.8221
5	20.40	"	"	.9754
6	20.44	"	"	.8643
7	20.56	"	"	.9647
8	20.60	"	"	.2190
9	20.60	267.4	.00320	.8347

Average=.00321.

While making the ninth measurement, I noticed that touching the fuses with the hands caused a decided increase in the resistance, and upon investigation it was found that a rise of over one per cent. resulted from the heating of the fuses when holding them firmly with one hand. After that discovery they were handled with greater care, and a drop which is noticeable in the curves was the result. The heating effect of the bridge battery, although very small, was also found sufficient to introduce a slight error, but by depressing the keys only for an instant the error was rendered negligible. A little latter I discovered that the indications of the thermometer which was hung near the fuses did not, by any means, represent the true temperature of the fuses. They had been heated by the alternating current to about 50° Centigrade, and had not been given sufficient time to cool down to the temperature of the room, the pine wood retaining the heat for a considerable period. It was, therefore, decided not to pass any current through the fuse for some time, but to measure the resistance, as before, from day to day, being very careful in getting the temperatures accurately; but in the latter I was not entirely successful. It was found practically impossible to get the temperature of the fuses correct within a few tenths of a degree because the temperature of the room would vary in spite of all care, and the fuses would not follow this variation so rapidly as the thermometer indicated it. Nevertheless, far better results were obtained than before.

The result of this part of the work is shown by the curves, Figs. 1 and 2, between the two heavy vertical lines.

After this the fuses were again subjected to the alternating current for about 100 hours, measurements of resistance being made daily. Each day, as the current was turned off, they were cooled down rapidly by taking them into a cold room, and leaving them for some time, after which they were brought back to the working room and allowed to stand for about five or six hours before measuring the resistances. The results are shown by the last part of the curves. As fuse No. 3 seemed to show greater irregularity than the others, another piece of the same sample was added. It is the one numbered 10, and the curve is plotted directly under No. 3 for comparison.

From the fourteenth point on, the curves are all practically straight horizontal lines, the irregularities being about the same when no current passed as when it did. Nearly all the points on the curves before the fourteenth were considerably higher. This shows plainly that the fuses had not cooled down to the temperature of the room when the resistance measurements were made, the variations depending on the length of time they were allowed to stand. Considering the average values of the last parts of the curves to represent the true resistances, the greatest variation was 1.8 per cent. in the case of No. 3, and even this is not too large to be explained by the above errors. In proof of this, I measured the resistance of one fuse immediately after turning off the current, and also 15, 20, 35 and 50 minutes later, and found the errors to be re-

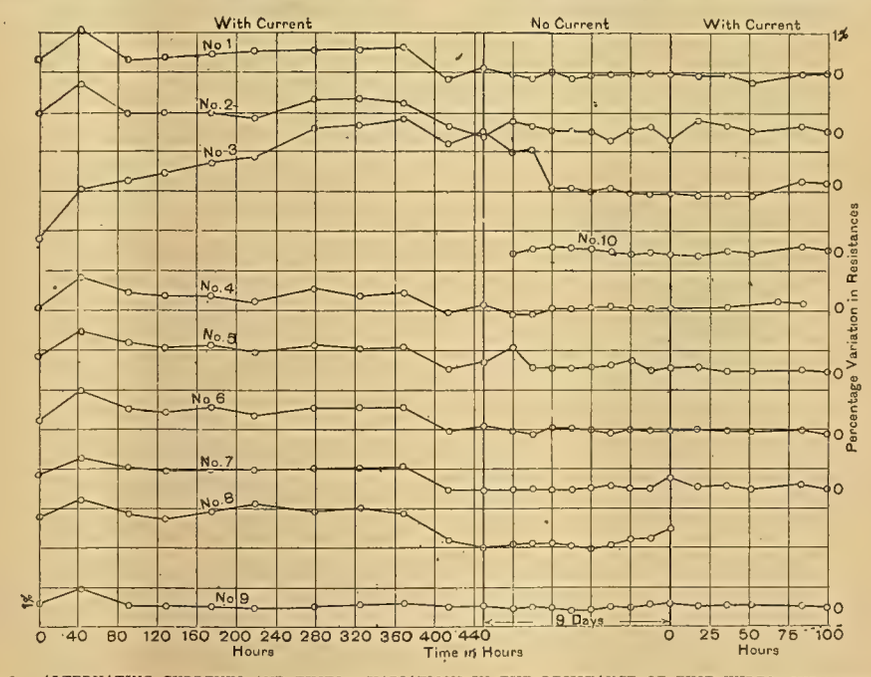


FIG. 2. ALTERNATING CURRENTS AND FUSES.—VARIATIONS IN THE RESISTANCE OF FUSE WIRES, SUBJECTED TO THE ACTION OF ALTERNATING CURRENTS; VERTICAL SCALE, 1 DIVISION EQUALS 1 PER CENT.

1. Read before the American Institute of Electrical Engineers, Philadelphia, May 16, 1894.

2. "The Action of Continuous and Alternating Currents on Fuse Metals," by C. P. Matthews, Transactions, vol. x., p. 251.

spectively 8 per cent., 6.2 per cent., 3 per cent., 2 3 per cent. and 1 per cent.

That the first point on each curve is nearly as low as the final values, is due to the fact that current had not been passing through the fuses before that measurement was made, and the fuses were, therefore, at the temperature of the surrounding air which was recovered by the thermometer. Another proof that the variations are due to temperature is shown by curve No. 9. This represents a wire which has a very small temperature coefficient, and accordingly, it varies the least of any. While the actual rise in curve No. 3 is much greater than in any of the others, the percentage rise is only slightly greater, the resistance of the fuse being the largest of all.

These experiments prove that there is no appreciable rise of resistance in fuses subjected to alternating currents, at least not within a period of 550 hours. More accurate results might undoubtedly have been obtained, had the fuses been mounted in such a manner as to avoid contact with any large masses of solid material, but the accuracy is amply sufficient to prove the case.

These results are diametrically opposed to those given in the report of similar work, published in the Transactions, vol. x., p. 262 already referred to. While, in the latter investigations, corrections were made for the standard resistance with which the fuses were compared, no such corrections were made for the fuse wires. The fuses were subjected to larger currents than in my tests, with consequent greater heating. The resistances were apparently measured without allowing sufficient time for the fuses to acquire the temperature of the room, and even if this was done, the variation in temperature of the room as given in the original report of the investigation* (which C. P. Matthews, instructor at Cornell University, kindly sent me) was sufficient to introduce serious errors. The resistances were measured by the fall of potential method. According to the drawing, showing the arrangement of the apparatus, no extra resistance is put in series with the battery to reduce the current strength. This current may have been sufficiently great, in the smaller sized fuses at least, to cause considerable heating. For these and other reasons relating to the accuracy of the tables, I think that this part of the work reported by Mr. Matthews is not to be relied upon, and, therefore, the conclusions based upon it are of no value.

2. THE EFFECT OF ALTERNATING CURRENTS ON THE FUSING POINTS.

Next the fusing points before and after passage of current were determined. As the continuous current from the dynamo which was available was too variable, I was obliged to use a few storage cells for fusing the wires.

A small, sensitive resistance which could be varied slowly was needed. A long german silver wire, stretched tightly, with a good spring clamp for a sliding contact, was found to serve admirably.

Six-inch lengths of the fuses were soldered to short, heavy copper wire terminals, the ends of which were amalgamated and dipped into mercury cups in making connections. The fuse, variable resistance, storage battery, and a Weston ammeter reading from 0 to 15 amperes, were placed in series. As the current approached the fusing point it was varied very slowly and gradually, giving it ample time to heat the fuse. Only the five ampere wires were tested. A number of pieces of each of these were tested; half of these had been subjected to the alternating current and half had not. I shall call these the "old" and the "new" samples respectively. Pieces of the old and the new of each sample were tested alternately so as to eliminate the errors caused by a change in the temperature of the room. The results are given in the following tables:

Nos. 3 and 10 New.	No. 3 Old.	No. 10 Old.
7.40	7.25	7.30
7.30	7.10	7.29
6.98	7.10	7.10
7.19	7.09	7.20
7.32	6.80	7.05
Average, 7.23	7.07	7.188
	Lowered 2.22 per cent.	Lowered .58 per cent.

No. 4.		No 5		No. 6.		No. 7.	
New	Old	New	Old	New	Old	New	Old
8.75	8.10	8.90	8.82	8.85	8.80	8.80	9.07
8.83	8.60	8.9	8.84	8.60	8.69	8.96	9.06
8.80	8.60	8.70	9.12	8.67	8.88	8.90	9.02
8.70	8.70	9.20	8.88	8.78	8.98	8.89	9.05
8.76	8.65	8.95	8.88	8.75	8.98	8.90	9.10
8.70	8.70	9.10	8.97	8.60	8.80	9.06	8.85
8.69	8.64	9.06	8.72	8.75	8.74	9.10	8.95
8.71	8.64	9.08	8.80	8.90	8.78	8.78	9.10
8.90	8.64	8.93	8.79	8.96	8.95	8.66	8.80
8.88	8.65	9.09	8.83	8.77	8.90	8.90	9.12
Average 8.795	8.632	8.941	8.863	8.743	8.842	8.895	9.012
Lowered 1.07 per cent.		Lowered .87 per cent.		Rise of 1.13 per cent		Rise of 1.32 per cent.	

Four of these samples show a slight lowering while two show a slight rise in the fusing point, but the differences are of the same order as the differences between individual test pieces. While a test of only a comparatively small number of fuses in this way hardly establishes the correctness of the results, a slight change in the fusing points probably did take place as is shown by the fair uniformity of the figures in each sample.

That such slight change as did occur was due to oxidation there is also little doubt, for all of the old fuses showed slight oxidation, and the effect is too small to be of practical moment.

As to the results in the earlier investigation already referred to (Transactions, vol x., p. 65) on the fusing points, only the averages are given, and no mention is made of temperature; therefore it is impossible to properly judge of their accuracy. As far as can be determined from the original report, however, the tests do not seem to be any more reliable than the resistance tests.

Sir David Salomons in the discussion of a paper, by A. C. Cockburn, read before the Society of Telegraph Engineers and Electricians in 1886, stated that fuses alter in two ways with time. Most of the metals, especially alloys, according to Alexander Siemens, being subject to slight oxidation, which lowers the fusing point.

Dr. Salomons' own experience, he says, was rather the other way, the fusing point being raised with long use.

Mr. Cockburn had the same experience. Mr. Matthews also states that the formation of oxides in the case of tin and the tin and lead alloys, may delay the fusion almost indefinitely, while the oxidation of copper and iron wire seems to favor its prompt fusion.

3. CONCLUSIONS.

In the light of the experiments herein described, and the statements made by Cockburn, Salomons and Matthews, is it necessary to ascribe a slight change in the properties of the fuse to the disintegrating effect of the alternating current? I think not.

In practice, a fuse is seldom obliged to carry a current equal to its full rated capacity. In electric lighting, for instance, the lamps protected by a fuse are not likely to be all turned on at once, and therefore the fuse is seldom carrying more than a small part of its rated capacity. The experiments that I have made, therefore, represent the conditions of ordinary practice and prove that a fuse as used in practice is not directly affected by the alternating currents.

Fuses on alternating current circuits are sometimes found to blow without apparent reason, but something outside of the disintegrating effect of the current is the cause. Under some conditions the result has come about through the mechanical shaking to which an alternating current fuse is sometimes subjected when not tightly clamped by the terminal screws.

Relative Advantages of Toothed and Smooth Core Armatures.[1]

By Alton D. Adams.

The merits of different methods of construction in the manufacture of dynamo-electric machinery, as in other lines, must evidently be decided by their comparative costs, all else being equal. Although questions concerning the relative merits of toothed and smooth core armatures have long been discussed, very little seems to have been written to show whether actual saving in cost may be effected by one construction over the other when employed to produce the same results.

The practice of dynamo builders in this country and abroad embodies both types, and the history of the art records many changes from each to the other. In view of the above the inquiry whether in the light of present facts any saving can be effected by the use of toothed core armature, seems of interest.

The limits of this paper do not permit consideration of this question in connection with all classes of electrical machinery, and its bearing on direct current constant pressure machines only will be taken up.

The principal disadvantages of toothed, compared with smooth core, armatures are greater first cost, large change of lead, excessive sparking, when used with too short air gaps, and the production of heat in pole pieces. Their advantages are that inductors are positively driven—large solid inductors, protected from eddy currents—and that a reduction may be made in the length and consequent magnetic resistance of the air gap.

Change of lead may be fixed within any desired limits, and sparking abated by such proportions of air gap and teeth as give them sufficient magnetic resistance.

Heat in pole pieces may be reduced by their lamination, by the use of very narrow teeth and slots, by forms of teeth that present a nearly continuous surface of iron to the pole pieces, and still more by the use of openings in core disks which do not cut through their outside surface, or a continuous magnetic sheath outside the teeth.

For any given form of tooth the heating of pole pieces is less the longer the air gap.

The mechanical strength of armature teeth, as usually employed, is far in excess of that required to hold inductors in position, even under conditions of short-circuit, and driving pins inserted in the core at proper intervals are much cheaper and take up less valuable room on the armature circumference.

Either teeth or substantial driving pins are, of course, preferable mechanically to the slender bits of hard fiber which have been much used, and frequently give way under the heavy strains to which large generators are subject.

When large wires or copper rods are used as inductors, their protection from eddy currents is an important matter, but proper stranding of inductors reduces the eddy loss in them, when used on smooth cores, to a very small amount, and has the further important advantage that inductors may be bent into the proper shape at armature ends, and the joints, necessary when rods are used, avoided.

The chief possible advantage, then, to be gained by the use of toothed armatures is through a reduction in the length of the air gap and the consequent reduction in the ampere turns required on field magnet, weight of copper, or energy in winding, and the length and weight of iron core. To make this advantage available, it must be practical to use air gaps shorter than are required for insulation, winding and clearance.

As is well understood, the armature winding of a dynamo or motor in operation has a magnetizing action which is measured in ampere turns for a bipolar machine by one-quarter the product of all the inductors of the armature into the total armature current. The ampere turns on the armature evidently tend to set up a flow of magnetism, having a complete circuit through the armature core, twice across each air gap, and through the iron of pole pieces.

1. Read at the meeting of the American Institute of Electrical Engineers, Philadelphia, May 16, 1894.

About half the ampere turns furnished by the inductors under pole pieces evidently act against the field ampere turns in each air gap at the polar tips, and the ratio between the armature and field ampere turns at this point necessary to give sparkless reversal there, must determine whether the required magnetic resistance be greater or less than that of an air gap long enough for insulation, winding and clearance with a smooth core armature.

As an armature coil in an operating dynamo or motor passes under the brush, the current flowing in it must stop, and one in the opposite direction be set up; and if this action is to be accomplished without sparking, a sufficient electromotive force must be provided in the coil while in direct contact with the brush. In the ordinary dynamo or motor magnetism forced across the path of the coil by the field ampere turns expended in air gap must provide this reversing electromotive force.

The data of a number of smooth core armature machines of different make show ratios of field to armature ampere turns in air gap of from about one and one-half to one to two and one-half to one, and the writer's experience is that ratio of two to one will give sparkless operation at full a load, with brushes set just outside pole corners.

It is a matter of common experience that the ratio between field and armature ampere turns in the air gap may be so reduced, even in machines with smooth core armatures, as to require excessive change of lead to secure even approximate freedom from sparking.

If it be desired, therefore, to build machines having an expenditure of field ampere turns in the air gap not much greater than those of the armature, we need not resort to toothed cores.

Take, for example, the case of a 260 ampere dynamo with 120 inductors on its armature in one layer, an air gap induction of 25,000 lines per square inch and 80 per cent. of inductors under the pole pieces.

An air gap of .45 inch between the armature and each pole piece will be sufficient for insulation, winding and clearance, and the field ampere turns expended in each air gap will therefore be 3,500, while the armature ampere turns, active under each pole tip, will be 3,100.

A considerable change of lead and sparking can be readily predicted for this machine.

In some types of small machines the room required by insulation, winding and clearance makes the air gap longer than necessary for sparkless operation, and in such machines the utility of teeth seems to depend on their cost compared with the saving to be effected by their use.

As the ampere turns furnished by the inductors under any pole piece grow less in a machine of given capacity, when the number of poles is increased, very short air gaps may be used, if the number of poles is sufficiently large.

As an increase in the number of poles usually makes a machine of given capacity more expensive, however, the question at once comes up, to what extent the number of poles may be increased without a greater expenditure than the saving of iron and copper to be effected.

In large multipolar machines of four or six poles, such as are commonly used, the length of air gap required for sparkless operation, is considerable, and those who have watched the development of these machines with toothed core armatures during the last four or five years have seen the air gaps gradually widen until machines of this character are not hard to find in which the copper inductors between the teeth could be taken out, wound outside the teeth, and still leave room enough for good clearance.

Additional mechanical security, of course, furnishes a considerable argument for the use of teeth in very large slow speed machines.

A number of devices have been suggested from time to time, to enable toothed core armatures to be used with short air gaps, and the consequent saving in iron and copper effected. No machines with these devices, however, have yet stood the test of time and competition with those of ordinary type, and have yet to prove their ability to produce results as at present attained at a less cost.

The seeming opportunity to save material by the use of toothed armatures is very attractive, and we cannot but hope it may some day be practical; in the light of present knowledge, however, there seems little to be gained by their use in medium and large bipolar machines.

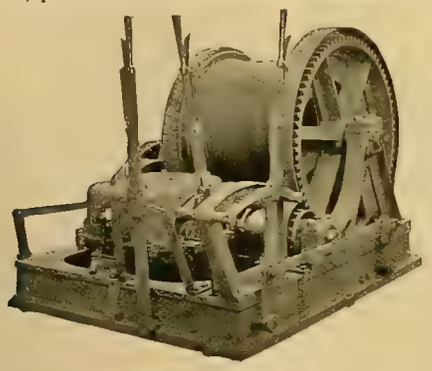
Rubber for Insulation.

Writing in the *New York Tribune*, W. R. Brixey says: "As a subscriber to your valuable paper, I beg to call your attention to an apparent error in article 'Where Rubber Comes From' (from 'Hardware'), in your issue of Sunday last. Being a manufacturer of rubber insulated wires, I would say that in no case, to my knowledge, is a manufacturer of this class of material using, as the article claims, cheap rubbers from the east coast of Mexico or Nicaragua, the rubbers used in compounds of high-grade insulated wires being invariably rubbers purchased on the Amazon, either Madeira or fine Para, costing at present market rates from 65 to 73 cents per pound, according to age, while for mechanical purposes there are undoubtedly cheaper grades of rubber consumed."

The West Shore Telephone company has been incorporated, and the general points to be connected are as follows: From Newburg, N. Y., to Saugerties, having stations in the several villages and towns between; also from Newburg to and through to towns of Marlborough, Lloyd, Kingston and Saugerties. The line is also to pass through the Wallkill valley; also connecting the towns and villages of Rosendale, New Paltz, Marbletown, Gardiner, Shawangunk and Plattekill; also, from the town of Lloyd, across the Hudson river, to and through Poughkeepsie. The capital stock is $3,500, divided into $25 shares.

Ironclad Motor Hoist.

The General Electric company has perfected its electric hoists, making them stronger, simpler and more compact. They are operated by motors of the railway type in which all the moving parts are thoroughly protected. The motor and the hoist are mounted on the same bed plate, as shown in the accompanying illustration, to which all bearings, levers, quadrants and other connections are attached, mak-



IRONCLAD MOTOR HOIST.

ing the machine complete in itself. The drum is provided with a powerful hand brake lined with wood and operated by a lever and is thrown in or cut of gear by a friction clutch of positive and reliable type, operated also by a lever. The motor is controlled by a rheostat of standard type which is thrown in or out by a lever. The pinion on the armature shaft and the intermediate gear with which it engages have machine cut teeth and are enclosed in an oil tight casing. The electric parts of the hoist are thoroughly insulated. These hoists are made in four, ten, fifteen, thirty, fifty and ninety horse power as usually rated.

New Street Railway Equipment of the Card Electric Company.

The Card Electric company, Mansfield, O., after experimenting for some time and equipping several lines of electric roads with its electric apparatus, with the object in view of establishing practical tests, has now placed its railway equipment upon the market and is preparing to push its introduction. In Fig. 1 is illustrated a rear view of the motor with the case closed. Attention is called to the rigidity of the frame and the steel bar for strengthening the cast extensions that form the spring supports. The bar rests in grooves cast for that purpose and is clamped down by two eye-bolts fastened by pins between the hinge ribs at the bottom and clips over the top, dividing the

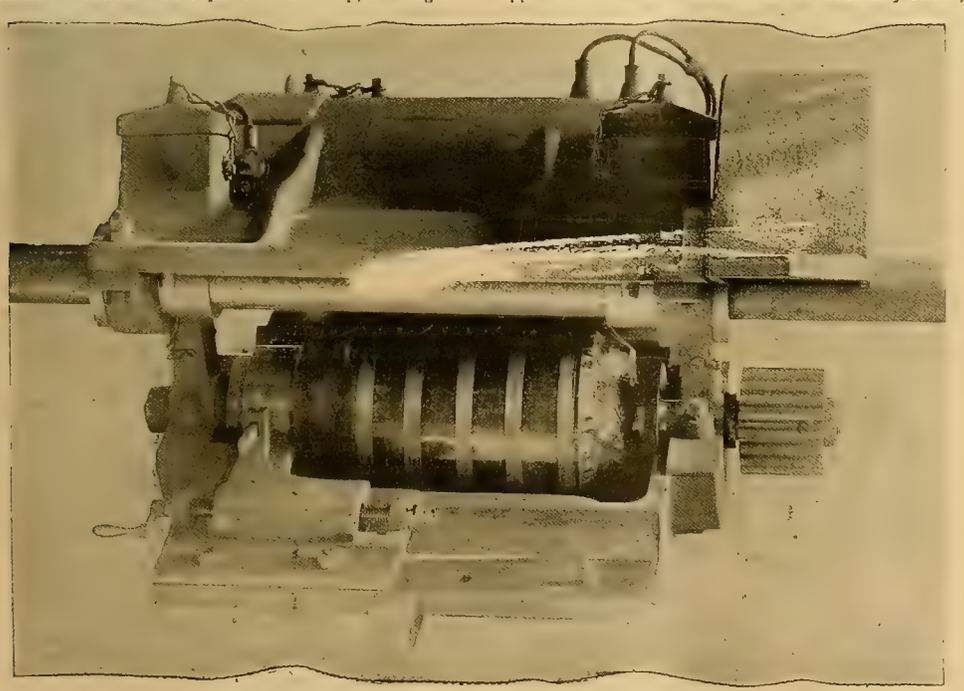


FIG. 2. NEW STREET RAILWAY EQUIPMENT OF THE CARD ELECTRIC COMPANY.

strain equally between four points, overcoming all danger of breaking after long service, through a gradual crystalization of the cast metal.

A novel feature of this motor is shown in Fig. 2, which illustrates a commutator turning attachment as well as a front view of the motor with a portion of the casing removed. This part of the apparatus is most essentially a time saver. With its aid the commutator may be turned off without removing the armature and be made absolutely true with the journals. The case can be opened, it is claimed, and the commutator turned off in no longer time than would be required to take the armature out and place it on the floor. When the motor case and armature is lowered, the pinion is released from the gear wheel and is used as a means for turning the armature. This is done with a leather belt making connection with the pulley and crank handle fastened to the case. The speed can be made anything desired. One attachment will answer for any number of motors.

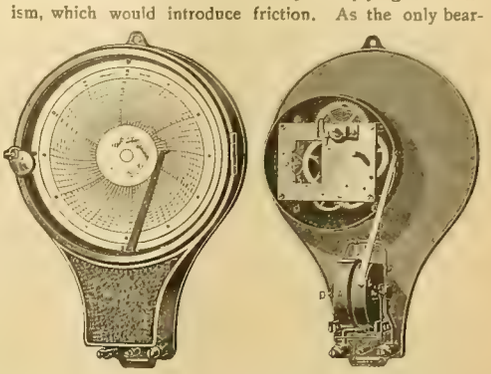
The controlling stand, the interior of which is illustrated in Fig. 3, is of extremely simple construction. The operating handle is placed centrally on top of the cover and turns a short shaft, from which motion is transmitted to another shaft, shown at the left, by means of two small sprocket wheels and a chain. Immediately under the cover is the reversing switch, the handle extending through the case at the right. On the longer shaft are placed eight cams, insulated from it by heavy, hard rubber tubing, and secured by hard rubber pins. Opposite each cam is a switch fastened by a suitable bracket or base to the back near the shaft. Each switch is provided with contact pieces to engage with clips on binding blocks fastened to the back. At the bottom of the stand is a series of binding blocks for making connection between controller, motor, resistance and the line. The western territory of the Card company has been placed under the charge of J. Holt Gates, Chicago.

Bristol's Recording Wattmeter.

A new recording wattmeter is being manufactured and introduced by the Bristol company of Waterbury, Conn., to supplement its present line of recording voltmeters.

FIG. 1. NEW STREET RAILWAY EQUIPMENT OF THE CARD ELECTRIC COMPANY.

The general design of the wattmeter is the same as that of the voltmeter, the principal modification being that a coil wound with a heavy conductor is substituted for one of the stationary coils of fine wire. Fig. 1 shows the instrument complete, ready for connection, while Fig. 2 shows the interior construction. In Fig. 2 the coil *A*, wound with fine wire, is mounted on the spring knife edge supports and is free to move toward the stationary coil *B*, which is wound with a heavy conductor capable of carrying the entire current to be measured. The terminals of the coil *A* are connected to the positive and negative conductors, and the magnetic effect of the current through this coil of high resistance will be dependent upon the voltage, while the magnetic effect of the main current through the coil *B* of low resistance will depend upon the number of amperes passing. The mutual attraction of the coils will be the product of these magnetic forces and proportional to the number of watts. The marking arm *F* is attached directly to one of the knife edge spring supports of the movable coil and partakes of its motion, recording the variations of electrical energy on a uniformly revolving chart. While the actual motion of the coil itself is quite small, it will be seen that the angular motion of the pen arm affords a sufficiently open scale on the chart without resort to ordinary multiplying mechanism, which would introduce friction. As the only bear-



FIGS. 1 AND 2. BRISTOL'S RECORDING WATTMETER.

ings in the instrument are the knife edge supports of the movable coil, it is extremely sensitive to the smallest changes of current. The magnetic balance principle involved in the construction makes it possible to entirely avoid the use of permanent magnets. The divisions on the chart shown in Fig. 1 are kilowatts, with a total range of 11 kilowatts. The stationary coil is designed for a maximum current of 100 amperes. For larger currents proportional shunts are employed.

Safety Cut-out Patent Litigation.

On May 29th Judge Dallas handed down a decision in the United States District Court at Philadelphia, in the case of Shapleigh against the Chester Electric Light & Power company. As stated in the WESTERN ELECTRICIAN of May 12th, the plaintiff, Marshall S. Shapleigh, brought suit against the defendant company to restrain it from an alleged patent infringement in using a safety cut-out for

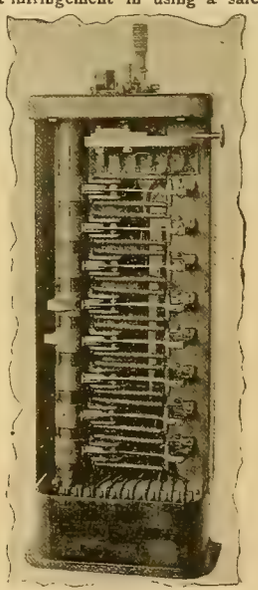


FIG. 3. NEW STREET RAILWAY EQUIPMENT OF THE CARD ELECTRIC COMPANY.

incandescent lamps which Mr. Shapleigh claimed was similar to one of his invention. The cut-out complained of was manufactured by the Emerson Electric Manufacturing company of St. Louis, which spent several thousand dollars in protecting its customer. The case has been in the courts nearly three years, and now the judge has decided in favor of the defendant and the Emerson company, holding that "defendant's device does not infringe the specific combination of the claims of the complainant's patent." This is a decided victory for the Emerson company.

Cornell Electrical Society.

During the last year an electrical society has been established at Cornell University, and at the present time it contains 48 active members. The first meeting of the organization was held on November 20, 1893, and on January 8th the first regular literary meeting was held, at which a paper was presented. Since the formation of the society ten papers have been read and discussed. The titles of these papers and the names of the authors are: "Lead Secondary Batteries," C. P. Matthews; "Counter Electro-

motive Force of the Voltaic Arc," T. J. Rogers; "Design and Construction of Power Stations," Prof. H. J. Ryan; "Power Station Switchboards," F. R. Slater; "Feeder Systems," S. A. Mason and O. P. Cummings; "Development of the Incandescent Lamp," Dr. E. L. Nichols; "High Speed Electric Railroading," W. R. Turnbull; "Notes on Some of the Works of Nikola Tesla," Eugene B. Clark; "Tesla High Frequency Phenomena," W. R. Quick; "Long Distance Transmission of Power," James Lyman.

The organization has received much encouragement from the faculty, and several of the professors have expressed their willingness to lend variety to the programmes with occasional talks. The papers read before the society have just been published under the direction of the publication committee, consisting of R. B. Daggett, W. R. Quick, O. P. Cummings, Q. A. Scott and C. E. Barry. The pamphlet also contains a list of officers and members, the constitution and by laws, and a brief sketch of the formation, work and purpose of the organization. That the society is an ambitious organization is shown by the announcement that "it is the hope of the society that this year's Annual will at least prove to be a worthy beginning to a long series of valuable publications, that shall mark the progress from year to year of a society that will rank among the foremost engineering societies in American universities."

Lincoln-Amstutz Experimental Apparatus.

The Scientific Machinist company, Cleveland, O., is about to place upon the market some apparatus which was designed especially for the students of the "Institute for the Home Study of Electricity," which is conducted by this company. In Fig. 1 is shown an illustration of the parts of the Lincoln-Amstutz experimental ¼ horse power dynamo and motor for students, schools and colleges.

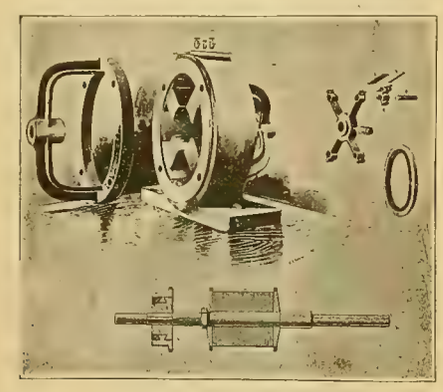


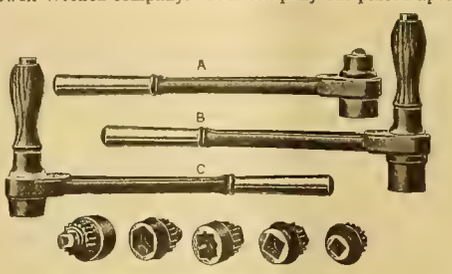
FIG. 1. LINCOLN AMSTUTZ EXPERIMENTAL APPARATUS.

This machine is of the iron-clad type, with poles projecting radially toward the center. It is fitted with self-oiling bearings of ample size, adjustable brush holder, two sets of copper brushes, and is in every respect a practical machine. In addition to the machine, four insulated rings are furnished, which may be secured and connected to the commutator for alternate current working. By the use of only one size of wire on the field and armature the machine is variably connected, and may be used as a four-pole shunt wound dynamo, a bipolar series dynamo or motor, a four-pole alternating current single phase dynamo, a three phase two-pole alternating current dynamo, as well as in a multitude of other applications.

A combination measuring instrument of the Lincoln-Amstutz type, Fig. 2, is furnished with the above machine. In this instrument an annealed soft-iron core is drawn into a magnetic field obliquely. To accomplish this the spool on which the coils are wound is made with an oblong opening, the height of which is four or five times its breadth. This allows the core the necessary freedom of motion. By the proper adjustments the direct reading scales can be made quite uniform from one end to the other. The instrument is wound with two coils, one of fine wire and the other of coarse. The coarse wire is connected between the two large terminals and the small wire between the small binding post and the large one next to it. The ammeter scale is calibrated with a Weston ammeter in series with the coarse wire coil. The voltmeter scale is calibrated with a Weston voltmeter in parallel with the fine wire coil. From the known resistance of the fine wire coil and the volts at its terminals the fractional part of an ampere in the fine wire coil is found and given on the scale of milliamperes. Both coils are connected to the circuit at the same time, a wire from one side being lead to the middle binding post; the current then flows through the coarse wire coil to the lamps and to the other side of the circuit. Another wire from the small binding post is carried to the other side of the circuit, so that the fine wire coil is in parallel with the coarse wire coil and the lamps, and is subject to the same voltage as the lamps. Both the fine and coarse wire coils tend to draw in the iron core, and by proper calibration the watts are read. Gravity is the force opposing the magnetic pull, and in setting up the instrument care must be used that the pointer stands at o.

Metropolitan Specialties.

Among the recent agencies taken by the Metropolitan Electric company, Chicago, is that for representing the Lowell Wrench company. This company has placed upon



METROPOLITAN SPECIALTIES.

the market a lag screw wrench, which is especially useful to telegraph, telephone and fire alarm constructors, and is designed for turning coach screws, nuts or bolts, either way, without taking off the wrench, among other applications. These wrenches are easily changeable for varicus sizes, by means of the different sockets. The wrench is shown in the accompanying illustration. This style of wrench, the sale of which the Metropolitan Electric company intends to push, has been long in use by the Boston and Worcester fire alarm departments, and has been made the subject of many flattering testimonials for the efficiency of its service. The Metropolitan company is the general western agent.

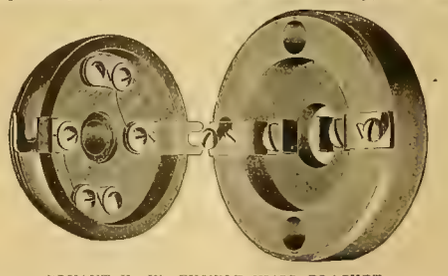
Bryant K. W. Fusible Wall Bracket.

The K. W. cut-outs hold a prominent place among the safety devices used for incandescent wiring. Among the number which the Bryant Electric company, the owner of the K. W. patents, has placed upon the market is the K. W. fusible wall bracket, shown in the accompanying illustration. The base screws up against the wall; the wires are led through the hole in the center and are fastened under the binding screws. The fuses, the cut-out being double pole, are in the cover. On the front of the cover is a polished brass wall plate, threaded for the reception of the ordinary wall bracket. The cover can be placed on the cut-out and the bracket left off until a building is entirely finished, thus protecting the wires and at the same time not offering any obstruction to the workmen. The Bryant Electric company's western office is in the Monadnock building, Chicago. Grier Brothers are the western representatives. Warerooms are connected with the western office.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 4.—The publication of the schedule of rates of the Metropolitan Telephone & Telegraph company, which took effect last Friday, for New



BRYANT K. W. FUSIBLE WALL BRACKET.

York, south of 110th street, attracted much attention. According to the new schedule 700 messages per year may be sent on a two-party line for $100, excess messages being charged for at the rate of $15 per 100. If a subscriber contracts for 1,000 calls a year he can obtain a telephone upon a direct line for $150, or upon a two-party line for $130, the excess charges being $12 per 100. The rates for service increase proportionately up to 2,000 calls, which may be obtained on a two-party line for $200 a year, or upon a direct line for $220, the rate for excess charges per 100 having decreased to $8. For more than 2,000 messages direct lines only will be used, and the rate of advance will be $5 per 100, with $7 per 100 for excess messages. For these rates metallic circuits lines will be used and equipped with long-distance transmitters. For a cabinet set $10 a year additional will be charged. An installation charge of $15 will be made for each station. Where an established station is brought under a message-rate contract, the installation charge will not be made.

A certificate of the consolidation of the Metropolitan Street Railway company with the Metropolitan Crosstown Railway company and the Lexington Avenue and Pavonia Ferry Railway companies was filed at Albany last week. The capital stock of the new corporation, which is to be known as the Metropolitan Street Railway company, is $13,000,000, and its directors are Herbert H. Vreeland, Thomas F. Ryan, R. S. Hayes, Albert W. Fletcher, H. S. Beattie and Ralph L. Anderton, Jr., of this city; Daniel S. Hasbrouck and Charles F. Warren of Brooklyn, and Henry A. Robinson of Yonkers. The new company assumes all the debts of the roads in the combination, which aggregate $9,250,000. The stock of the new company is to be given share for share for that of the companies combined, and the capital stock is equal to the combined stock of the three.

The first car over the Brooklyn City Railroad company's new trolley route to North Beach, L. I., by way of Newtown, was run last Thursday. The car made the trip from the company's depot on Grand street, Maspeth, to the beach in exactly twenty minutes. Flags were waved, and North Beachers cheered as the car came to a stop. Its passengers, consisting of officers of the road, were entertained by President Foster.

In building the extension of the Fifth Avenue branch of

FIG. 2. LINCOLN-AMSTUTZ EXPERIMENTAL APPARATUS.

the Brooklyn elevated railroad to the city line at Sixty-seventh street and Third avenue, the company experienced an interesting complication. While hoisting into position the first of the last four 65 feet longitudinal girders necessary to connect two sections, the end not yet in position came in contact with the transverse girder. Immediately the metal was melted and an electric arc was formed, and the melted iron fell to the street. After several attempts to swing the girder into position the trouble was located. The insulation of one of the feed wires of the Brooklyn City Railroad company's trolley line, which was strung on one side of the elevated posts, had worn so that the live wire came in contact with and charged the structure. The negative current which completed the circuit, reached the iron work from underground, at a point on the other side of the unfinished section, and the contact between the two parts of the structure completed the circuit and caused the fusion. After diverting the course of the current by means of copper wire the work of completing the road progressed. Although in many other ways (such as the corroding of foundation bolts, water pipes used for supplying stations, and angle bars attached to the tranverse girders, etc.), the escape from electric currents of the trolley roads has proved damaging to the elevated structure, it has also benefited the elevated railroad people by saving the amount necessary to maintain batteries for operating the telegraph lines over the roads. The Brooklyn Elevated Railroad company, it is claimed, uses nothing but a borrowed current for operating its telegraph wires. This is accomplished in most cases by running a

wire into the ground and connecting it with a gas or water pipe, which readily appropriates a sufficient current from the street car line. But the Brooklyn Heights surface road is fast paralleling its feed wires by equally heavy return wires, so that the elevated road officials who, but for this, might successfully plan to light the stations and even operate the road as they run their telegraph, will probably have to fall back on their own resources.

W. F. O.

PERSONAL.

Reid Carpenter, president of the Card Electric company, Mansfield, O., was in Chicago last Saturday.

J. H. Rhotehamel, president of the Columbia Incandescent Lamp company, St. Louis, Mo., has just returned from a trip to New York.

Louis Nahm, secretary of the American Electrical Manufacturing company, St. Louis, has returned from a four weeks' trip through the West.

A. Robert Harvey, general manager of the Accumulator Electric Storage Battery company of Liverpool, England, is spending a few days in Philadelphia and New York in order to become familiar with some of the important features of the storage battery business in this country.

NEW INCORPORATIONS.

Fort Wayne Electric Manufacturing company, Fort Wayne, Ind.; capital stock $10,000; to manufacture incandescent lamps and electrical appliances; Fred Eckert, Fort Wayne, Ind.

ELECTRIC LIGHTING.

Irvington, N. Y., is contemplating the introduction of electric lighting.

An arc and incandescent electric lighting plant will be constructed at Harrodsburg, Ky.

Arrangements are about completed for the electric lighting system at Amherstberg, Ont.

It has been decided to put isolated electric plants in the courthouse and jail at Denver, Colo., at once.

The Fenelon Falls, Ont., Electric Light company has been incorporated with a capital stock of $3,000 to supply electric current for commercial purposes.

The electrical committee of the Rochester, N. Y., Common Council has decided to light State street, one of the principal thoroughfares, by double incandescent arc lights.

Sealed proposals for the construction of an electric light plant were opened by the common council of St. Johns, Mich., last month. It is expected that the plant will be in operation by August 1st.

The project of electrically lighting the streets of Bourbonnais, Ill., has been receiving considerable consideration. The Kankakee Electric company has submitted a proposition to furnish arc lights.

Cook Brothers, Hensall, Ont., will install a 350 light alternating dynamo for lighting the town. The contract for the electrical apparatus has been placed with the Royal Electric company, Montreal.

The London Tramways company is running a car on its line in which incandescent lamps, supplied with current by a storage battery, are placed. One lamp is placed upon an iron frame six feet above the car roof, for the use of outside passengers.

ELECTRIC RAILWAYS.

Omaha, Neb., is investigating the electrolysis which has caused considerable trouble in the water and gas pipes of that place. An electric street railway furnishes the explanation of the question.

The Atlantic Avenue Railway company of Brooklyn has bought three of the electric cars used on the Intramural road at the World's Fair, for use on its Coney Island and Thirty-ninth street ferry line. If successful there they will be used in the city also, it is said.

The Thomson Welding company has shipped a motor dynamo car to Brooklyn, N. Y. It was built for the Johnson company of Johnstown, Pa., and will be used in Brooklyn by the electrical department of that company for welding rails for the Nassau electric railroad.

The town of Halle, Germany, had a horse railway, which, during the year 1891, gave a deficit of $9,500 after two years' working. Then electricity was installed and its first year's service gave a surplus, it is said, of $12,000. The mileage was extended two and a half miles, and 2,667,000 passengers were carried.

The Peoria Royal Electric company will begin the establishment of an electric light system for Viroqua, Wis., in a short time. The city has given a contract for lighting the streets and public buildings. Every business house in the city has contracted for the service. The system is to be completed July 15th.

The Mohnsville & Adamstown, Pa., electric railway will be constructed on a novel basis. It is a reminder of primitive days of railroading and road building. No bonds will be issued, but farmers along the way are to furnish labor, teams, wagons, poles and ties, taking stock of the company in part payment. If the plan is a success, it should greatly increase the possibilities of country electric roads.

As a necessary adjunct of the electric railway to be built around Grand Island, near Buffalo, N. Y., there will be one and one-half miles of road extending from the city line at O'Neil street—where connection will be made with the Buffalo railway system—down the river to the Bedell House ferry. It is said that the piece of road mentioned will be built this season, and work on it will probably be begun at once.

The plan of an electric railway between Philadelphia and Harrisburg, Pa., is being rapidly pushed forward under the direction of the Pennsylvania Traction company, of which J. J. Patterson of Lancaster is president. The roadbed will be of the best construction, a seventy pound rail will be used, and there will be no grades exceeding four per cent. The company is now in consultation with the electrical manufacturing concerns, in reference to the question of installing a number of power stations or long-distance transmission plants with motor generators.

MISCELLANEOUS.

Suit has been brought by John E. Ridall against the Brush Electric Light company in Pittsburg for $135,000 claimed to be due as commission on sales made in his territory for the company. The secretary and general manager of the company, S. M. Hamill, claims that nothing can be secured by Mr. Ridall under any circumstances until the Brush company has received the damages granted by the courts against the Western Electric and Westinghouse companies.

The electrical workers of Los Angeles, Cal., have suggested to the fire commissioners of that city that the council be asked to pass an ordinance compelling all companies using circuits carrying currents of high voltage to designate those wires by using only wires insulated by some special color of insulation, or by painting the insulators to which the wires are tied, in a manner that will enable the workmen to readily understand the nature of all circuits.

A raid was made last week in Chicago upon some of the "bucket shops" by the police and a number of electricians employed by the city. Wires, which were supposed to furnish telegraphic quotations on stocks and bonds and race track reports, were cut, but in some instances the cutting of the wire had no effect upon the telegraphic instruments. The method employed by keepers of these exchanges for cheating the public by bogus machinery has already been described in the columns of the WESTERN ELECTRICIAN.

TRADE NEWS.

The Wallace Electric company, Chicago, reports a large number of sales of the W. W. lightning arrester and the Wirt brush. The company is carrying a complete stock of fan motors, both for alternating and direct current, 12-inch and 24-inch fans, battery motors, in fact a complete stock. A catalogue of these goods will be out in a short time.

The General Electric Launch company is building at Morris Heights, on the Harlem river, an electric launch for Congressman Sorg of Ohio. The launch is to be 46 feet over all, will carry two motors, a twin screw, and 144 cells of the Consolidated Electric Storage company's battery. A speed of twelve miles an hour will be attained.

The Gilliland Telephone company, located at 186-188 Fifth avenue, Chicago, was recently organized to manufacture telephones, telephone switchboards, speaking tube apparatus and other specialties. Its correspondence has already become large and several contracts for systems in offices and factories have been made. The company is a contractor principally for telephone exchange installations and private line construction.

W. H. Beatty, who was for several years connected with the Novelty Electric company of Philadelphia, has accepted the situation of general sales agent, in charge of the electrical department for the Hubley Manufacturing company of Lancaster, Pa. Mr. Beatty has a large acquaintance in the electrical trade, who will wish him success in his new position and his patrons in the West may look for a call from him soon, in the interest of his company.

Among the recent orders received by the Missouri Electrical Repair company, St. Louis, Mo., of which E. B. Tyler is manager, are the following: One 125 light Colburn machine for the E. O. Standard Milling company; a 700 light Colburn machine for the Nicholson hotel, Nashville, Tenn.; an isolated plant for the Alton, Ill., Rolling Mill company, and one for the C. C. Shelton Milling company, Chattanooga, Tenn. The company carries in stock a large number of new style Thomson-Houston arc dynamo armatures.

J. Holt Gates has been appointed general western agent for the Card Electric company's street railway motors, made at Mansfield, O. The Card company has been at work with its motor for the last year and a half and has cars in operation by the Citizens' Street Railway company, Mansfield, O., and by the Fremont, O., Street Railway company. They are said to be giving excellent service, as they have all the latest improvements and many features not contained in other motors. The Card Electric company's office for the western country will be at 1139 and 1140 Monadnock building, Chicago. Mr. Gates still retains his relations with the Mather company, which is now making a specialty of large street railway generators. Eight of 250 horse power each were recently sold.

The Central Electric company, Chicago, makes the announcement that it has a complete line of Paiste's Xntric switches. These switches have become well known to the trade, and while the company has kept them in stock for some time it has not been pushing their sale until recently. The company has lately taken the agency for Seufurt's German commutator compound. This is a new preparation in this section of the country, but has established a very favorable reputation where it had been used. The company has hardly as yet fully settled its stock in its new store, but the rooms present every opportunity for a thorough inspection. The show windows of the Central company are attracting much attention, especially the one in which is displayed a fine line of fan motors.

One of the most important agencies which the Metropolitan Electric company, Chicago, has yet taken is that of general western agent for the Kester arc lamps, manufactured by the F. P. Little Electrical Construction & Supply company, Buffalo, N. Y. These lamps are made for all systems, both alternating and direct, on constant current circuits. Several styles of this type of lamp are on exhibition at the company's store. They are intended for both exterior and interior lighting, the latter class being highly ornamental in appearance and meeting all the demands of the underwriters' requirements. F. E. Parker of the F. P. Little company is now associated with the Metropolitan company assisting it to introduce the lamp thoroughly in the West. A large stock of this specialty will be carried by the company and orders will be filled promptly.

When it comes to getting out a sumptuous technical catalogue the Germans acknowledge superiority to none. An example of this is the beautiful volume recently issued by the Allgemeine Elektricitaets Gesellschaft of Berlin, under the title, "Elektrische Beleuchtung und Kraftuebertragung: Hilfsbuch zur Anfertigung von Projekten und Kostenanschlaegen" (Electric Lighting and Power Transmission—A Guide in Considering Projects and Making Estimates). This production is a fine specimen of German book-making. It has heavy stamped celluloid covers, carefully drawn colored maps of Germany, Europe and the world, chromo-lithographs showing the company's works, and is elegantly printed in two colors on heavy paper, with many acceptable wood engravings. The whole subject of electrical supply is very elaborately considered, with many useful tables, and apparently every commercial question that could possibly arise in connection with any sort of an electrical installation is answered. The book will form a valuable and very ornamental addition to any technical library. It is stated that an English translation will soon appear.

The Independent Electric company, Thirty-ninth street and Stewart avenue, Chicago, has issued a descriptive circular and illustrated price list of tested fuse wire and links calling attention to its specialties in this line. The book contains a number of interesting and valuable tables regarding fuses and wires, and also a number of illustrations. In the back of the book is reproduced an article on safety fuses by Charles A. Pratt, electrical engineer for the company, which will be found to cover the ground thoroughly. In using fuse wire the length of the wire between binding posts, should be taken into consideration since this length has an important bearing on the fusing point. The most advisable length for each particular size of wire will be found in one of the tables. If wire is used in shorter pieces than there given, its carrying capacity will be raised. If fuse links are used all chance for error on account of mistakes in length is eliminated, therefore it is advisable to use them in place of wire. This is especially the case when the replacing of fuses has to be entrusted to men who imperfectly understand the importance of such details. All of the company's fuse links have the carrying capacity plainly stamped on the copper terminal.

BUSINESS.

The business of the Ball & Wood company has so far recovered from the general business depression that the company finds it necessary to increase its force by the addition of a night gang. The works will be run to their full capacity, twenty-four hours a day, which speaks well for the reputation of the company's engines.

The American Electrical Manufacturing company, 2011 to 2017 Pine street, St. Louis, has met with an increasing demand for its popular American and Republic incandescent lamps. The company has received several unusually large orders of late which has kept it behind in filling other orders. It is now prepared, however, to fill orders promptly as usual.

The Interstate Complete Electric Construction company, St. Louis, Mo., has installed a 1,000 light alternator of the United Electric Improvement company's make, in Grass Valley, Cal. The company carries in stock a complete line of switches, insulating joints, cut-outs, etc., and has lately secured some gratifying orders. It has besides a number of electric light specialties which ought to be particularly useful to every electric light plant.

The Electric Appliance company, Chicago, is doing a satisfactory business in the Meston alternating fan motor, notwithstanding the fact that the temperature has been rather against that electrical appliance until recently. Hot weather has come, however, and at least some of the trade believed in being prepared for it. The company is exhibiting in its Madison street show windows a line of the Carpenter electric heating and cooking appliances which is attacting considerable attention.

The Columbia Carriage & Cycle company, Milwaukee, is advertising one of the best all-round road wheels on the market. Having made arrangements to build an immense quantity of them this year, and wishing to get them more thoroughly introduced, the company has made a net price to consumers that is lower than the same grade of wheel can be sold on a wholesale basis. This is a splendid opportunity to secure a high-grade American wheel at a great reduction, and in getting it from a reliable house, which furnishes written guarantees

with its wheels, one may depend upon securing a thoroughly satisfactory machine.

The Mather Electric company, Manchester, Conn., is bringing out a new type of railway generator of large capacity, with complete station equipment of entirely new and original design, and embodying a number of important improvements in this class of apparatus. A detailed description of these new generators will be of interest. The Mather Electric company has secured a number of contracts for future delivery for these new large generators on some of the most important electric railways in this country.

On May 26th Hawarden, Ia., awarded the contract for its incandescent electric lighting plant to J. H. Winchel, Le Mars, Ia., under plans and specifications prepared by William H. Bryan, consulting engineer, St. Louis. The contract covers a 36 kilowatt slow speed alternator, a 12 by 30 inch Corliss engine, two 80 horse power steel boilers, primary and secondary construction for 1,000 16 candle power indoor lights and 50 32 candle power streets lights. The work is to be finished within ninety days, but the plant will probably be running much sooner. Owing to the very favorable cash terms offered, this contract was placed at remarkably low figures.

The Hubley Manufacturing company, of Lancaster, Pa., recently organized an electrical department. A number of new devices in the electrical line, which have been tested in practical use for several months, will be exploited. The company is now building an addition to its factory for the accommodation of its new department. Secretary F. H. Steacy reports that the company will also handle a full line of supplies for street railway and central station work. The contract for furnishing the Hanover Electric Light, Heat & Power company with complete material for building its lines has been given to the company. It has also received the order from the Citizens' Light, Heat & Power company of Lancaster for nearly 75 miles of insulated wire, including the majority of supplies required by it to build its lines now being constructed.

After a series of exhaustive tests, covering a period of six months, conducted at the Edison laboratory by W. K. L. Dickson, Mr. Edison's consulting electrical engineer, the chloride accumulator has been adopted for use with the Edison kinetoscope. The following is Mr. Dickson's letter announcing the result of his tests: "At your request it gives me great pleasure to state that, after testing the leading makes of storage batteries in connection with the Edison kinetoscope, I have given the preference as to capacity, mechanical construction and durability to your chloride accumulator, which stands unique among its competitors, marking an important stride in the right direction, and being capable of application to varied uses." The Electric Storage Battery company has opened a New York office at 45 Broadway.

The strike of the coal miners in the United States and the consequent scarcity of coal has opened a field for using oil as fuel, which has met with considerable favor among electric light plants. Oil as fuel has been used successfully for a number of years, but it remained for the present coal famine to bring the system into more practical use. The John R. Armstrong Manufacturing company, Chicago, has on the market a fuel oil burner which seems to be giving thorough satisfaction in the large number of plants where it is used. The company makes some very strong claims for its burner. It is said to be odorless, smokeless, noiseless and a great fuel saver. The company has recently completed an installation of over 100 of these burners in the plant of the Pioneer Fire Proof company, Ottawa, Ill., which were installed since the coal strike commenced.

The Metropolitan Electric company, Chicago, has upon exhibition in its store a fan motor combination, manufactured by the Knapp Electric Manufacturing company of New York, which is attracting considerable interest. It consists of a fan motor and a battery of three cells mounted in a box and intended to be placed in any convenient place out of the way. The company is thoroughly provided for the warm weather season and carries a fine line of fan motors. It announces a large demand for Mac tape, which has become a very popular article among electrical men. The company is calling attention to its full line of all kinds of switches, particularly double pole and double throw instruments. The Xntric switches of five, ten and fifteen amperes capacity, three-way, single and double pole have also been meeting with a ready sale. The company is sending out to the trade a sample of motor cloth for motor curtains. This cloth is very strong, is water proof, pliable and elastic.

That business is brisk with the Chas. E. Gregory company, Chicago, is evidenced by the following partial list of recent sales: T. W. Webster, Bay City, Mich., 10 horse power Jenney motor; C. E. Woodruff & Co., Chicago, 30 Thomson-Houston arc lamps; Western Telephone Construction company, Chicago, five horse power Siemens dynamo; Perkins & France, Chicago Heights, 150 light Edison dynamo; J. M. Lee, Superior, Neb., 30 light Sperry arc dynamo and lamps; Bay County Electric company, Bay City, Mich., 200 light Westinghouse dynamo; Lewis Rice, Philadelphia, 15 horse power Sprague motor; Gault House, Chicago, 20 kilowatt G. & C. generator; Leonard & Slater, Chicago, 10 horse power Thomson-Houston motor; Wells Goodhue, Chicago, 10 horse power Rockford motor; Antigo Edison company, Antigo, Wis., 15 light arc plant; U. S. Artillery School, Ft. Monroe, Va., 12 light Thomson-Houtson arc dynamo and lamps; W. W. Low, Chicago, 50 light Westinghouse dynamo; Norton Bros., Chicago, 200 light Westinghouse plant; Monarch Refrigerating company, Chicago, 150 light Westinghouse plant; M. J. Steffens, Chicago, 40 light Crocker-Wheeler dynamo. The company has also made a large number of smaller sales. During the recent hot spell 93 fan motors were sold in eight days. The company also reports a brisk business in odd instruments, arc lamps, and ventilating apparatus.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued May 29, 1894

520,406. Magneto Telephone. Arthur F. Boardman, Somerville, Mass.

An improved construction, consisting of a casing for a ring magnet, combined with the magnet by means of a non-magnetic yoke whose ends engage the ring magnet secured at its middle to the casing, is the main part of the invention.

520,412. Insulator. Chauncy E. Conover, Cincinnati, O.

The object of the invention is to obtain an insulator that will retain the wires therein without the aid of tie wires. It is intended principally for electric lighting circuits.

520,427. Circuit Closer. George W. Hey, Syracuse, N. Y.

The invention consists principally in a movable terminal, a second terminal movable toward the former terminal, and means for forcing the movable terminal from its operative position for releasing the movable terminal when in its inoperative position, and for holding the second terminal in operative position.

520,429. Electric Battery. Samuel H. Hoggson, St. Louis, Mo.

The object is to provide a light, portable and cheap receptacle for holding a battery having a number of cells. An additional feature consists of improved means for providing electrical connection between the battery cells without the use of bolts, screws or wires.

520,435. Electric Cigar Lighter. David Misell, New York, N. Y.

This invention relates to a cigar lighter which is so constructed that by depressing a spring plunger an electric current will be generated for heating an incandescent wire, by which a dip may be lighted.

520,467. Speaking Attachment for Telephones. William Weber, Philadelphia, Pa.

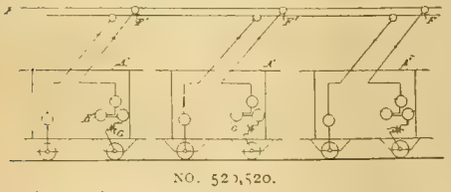
Means are employed upon telephones to prevent the flexible tube becoming twisted, and also to enable the mouthpiece of the speaking tube to be moved nearer to or farther from the speaker.

520,474. Switch. Henry P. Ball, Bridgeport, Conn.

The principal claims for this invention are for a jack-knife switch composed of sheet metal, consisting of a movable portion formed of single strips of conducting material mounted upon a base, the blades being distorted to afford a contact for the circuit wires, and the end of the blade being returned over the wire and secured in place by a screw adapted to compress the parts together.

520,520. Safety System for Railroads. William H. Elkins, Cambridge, Mass.

The main object of the invention is to cause the too close approach of one train to another, to give warning to the engineer, or on a closer approach to stop the trains. In the drawing is illustrated the system as applied to electric railways. The wire F is of high resistance, and connects the trains A^1 A^2 A^3 by extra trolleys, F^1 F^2 F^3, so that any two trains on the same track are in one circuit, whose resistance depends largely upon the strength of the resistance wire F, between the two trolleys. If the resistance on the wire between the trains A^1 and A^2 is, say, 100 ohms at a minimum distance for safety, and the



NO. 520,520.

electromotive force of batteries G^1 and G^2 be each 25 volts, the current in the circuit of which the trains A^1 A^2 form part, will be less than one-half an ampere; and indicators are so adjusted that the index will be between zero and safety; and the bells will not be sounded, they being adjusted to require, say, a current of at least one ampere. Upon the nearer approach of trains the resistance decreases, ringing the bells until the current in the safety circuit grows until of sufficient strength to cause magnet K^1 to attract its armature, which applies brakes in a simple manner.

520,543. Testing System for Multiple Switchboards. Charles E. Scribner, Chicago, Ill.

The object of the invention is to provide a test signal that may be readily distinguishable from false signals produced by accidental and extraneous causes.

520,547. Fire Alarm Apparatus. Frederick J. Thunhorst, Allegheny, Pa.

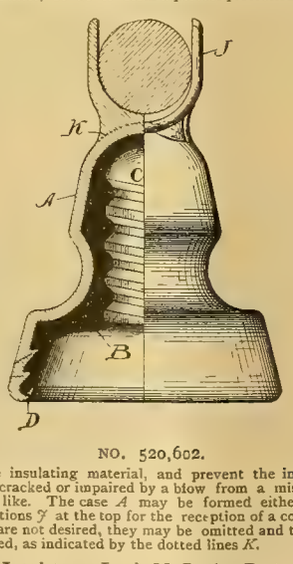
In his invention the inventor claims principally the combination with an electric signal of a spring arm adapted to close an electric circuit, a wire secured to this arm and to a fixed support, a series of tension cords of inflammable material engaging the wire and drawing the wire sufficiently taut to cause the arm to break the circuit, inflammable cords connecting the tension cords, and non-combustible links between the ends of the connecting cords.

520,585. Electric Clock Striking Mechanism. Charles D. Warner, Ansonia, Conn.

The invention comprises electric apparatus for operating the striking mechanism of a clock of large dimensions, or of any similar mechanism embodying heavy and relatively slow moving bell hammers.

520,602. Insulator. Henry H. Luscomb, Hartford, Conn.

In the drawing A is an outer metallic shell, entirely covering the interior portions which comprise the insulating material B, which may be provided with an interior cavity, C. The lower edge of the case or bell is formed with a tapering lip, D, projecting inwardly. After the insulating material is in place the free edge of the lip is turned upward slightly, as shown by the full lines, so as to form a perfect protection for the edge



NO. 520,602.

of the insulating material, and prevent the insulation from being cracked or impaired by a blow from a misplaced trolley or the like. The case A may be formed either with upward projections J at the top for the reception of a conductor, or, if these are not desired, they may be omitted and the top may be rounded, as indicated by the dotted lines K.

520,606. Insulator. Louis McCarthy, Boston, Mass.

An invention consisting of a case, a connecting piece within the case and insulating material to insulate one from the other, a cap for the case, secured in place by bending the edges of the case over the cap, the connecting piece being provided on that portion thereof which is outside the case, with a shoulder, and having a series of sheets of mica interposed between the shoulder and the proximate portions of the case, whereby all portions of the connecting pieces are insulated from the case.

520,614. Element for Secondary Batteries. Sigmund A. Rosenthal and Villeroy C. Doubleday, London, Eng.

The invention is a secondary battery element comprising a perforated and corrugated plate or sheet of lead provided with a connecting tang, the diameter of which differs at different points of its length, an active material in which the plate is embedded, and an inclosing casing or box in which the embedded plate is firmly held, the box constructed of a perforated non-conductive rigid material and provided with an opening of the same size as the portion of least diameter of the tank.

520,620. Alternating Current Motor. William Stanley, Jr., Pittsfield, Mass.

The invention consists in a new method for operating a mechanical condenser, in combination with an alternating current circuit, as a means for neutralizing the effects of self-induction in it.

520,661. Electric Railway Signal. Charles Selden and Henry V. Riley, Baltimore, Md.

The invention relates to that class of signals employed for the purpose of causing a visual or audible signal, to be operated by railway trains or cars approaching in either direction on a railroad.

520,673. Therapeutic Electrode. William B. Farrar, Greensborough, N. C.

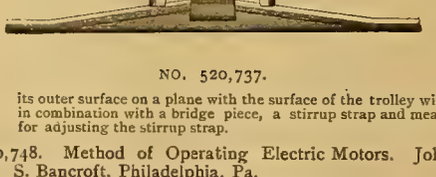
It is one of the purposes of the invention to provide a simple and convenient apparatus for the transmission of electric currents through any or all parts of the human body, and in opposite directions, provision being made whereby the current may be reversed by the patient without removing the hands from the electrodes.

520,710. Electric Railway Signal. Charles Selden and Henry V. Riley, Baltimore, Md.

The invention is somewhat similar to patent 520,661, and is especially useful as a warning signal at a roadway crossing.

520,737. Trolley Wire Support. Budd J. Jones, Sioux City, Ia.

As seen by the cut the invention consists of a trolley wire support, in which the supporting piece is of an approximately triangular form, adapted to fit a bend in the trolley wire, with



NO. 520,737.

its outer surface on a plane with the surface of the trolley wire, in combination with a bridge piece, a stirrup strap and means for adjusting the stirrup strap.

520,748. Method of Operating Electric Motors. John S. Bancroft, Philadelphia, Pa.

Claim 1 reads:

Two or more motors, the fields of which are excited by a current of constant potential and their armatures operated from a separate generator, producing a current the potential of which may be varied, a reversing rheostat switch for the armature circuit of each motor and means whereby the motor fields are supplied with current in advance of the field of the generator that produces the current for the motor armatures.

Another claim reads:

A rheostat switch that regulates the admission of current to the field of a generator, a rheostat switch that admits current of a constant potential to the field of a motor, in combination with an interlocking device between the two switch levers.

520,758. Conduit Railway Trolley. William Lawrence, New York, N. Y.

The invention relates to means for enabling wheeled current conveyors for electrically propelled vehicles to easily conform to any curve that may occur in the electric wire, so that the wheels of the conveyor may be prevented from leaving the wire when the conveyor is traveling around curves.

Western Electrician.

EVERY SATURDAY.

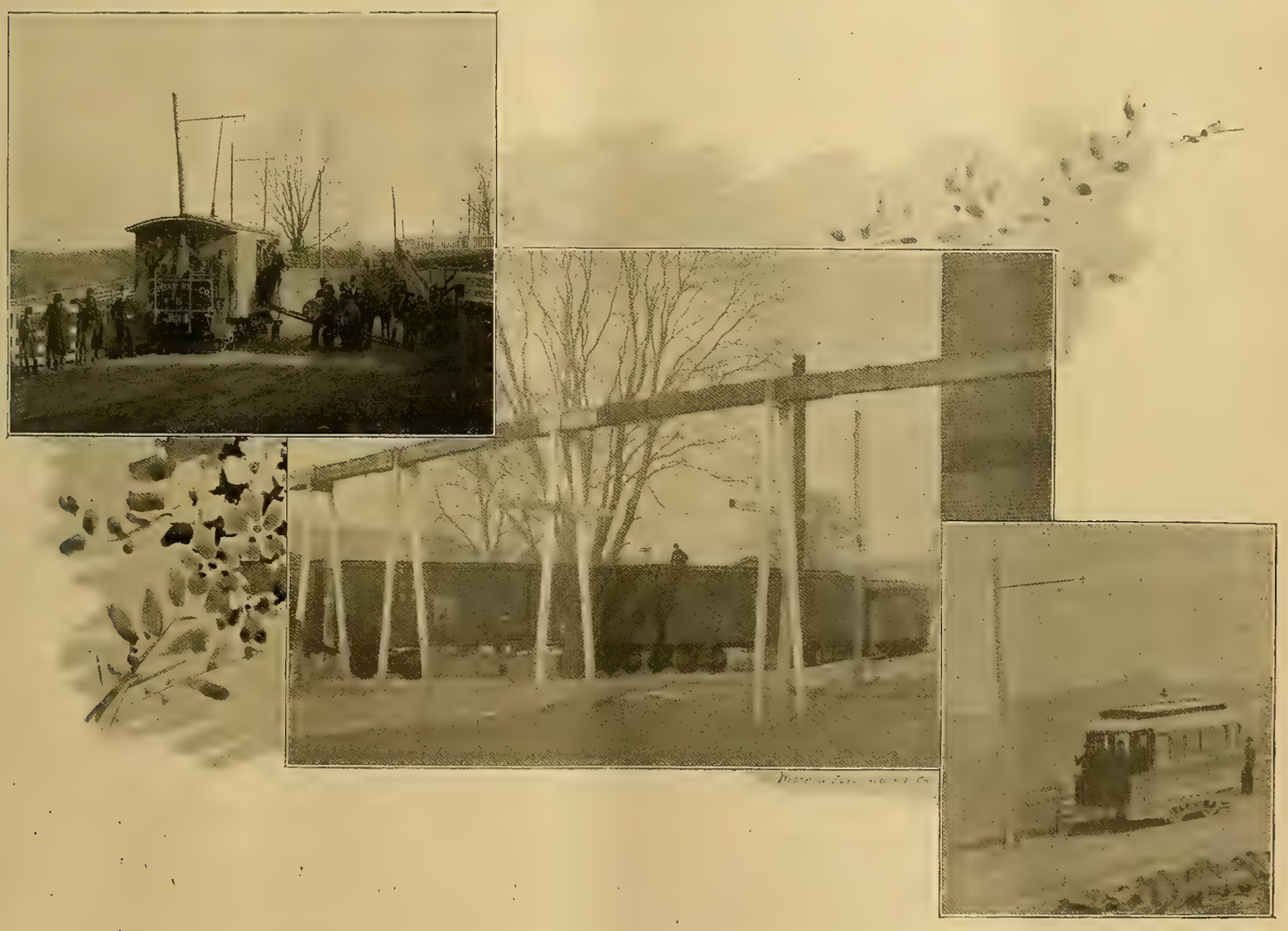
Vol. XIV. CHICAGO, JUNE 16, 1894. No. 24

Passenger and Freight Electric Road In Kentucky.

Kentucky has not as yet proven to be such an attractive field to the electric street railway projector as have some of those states whose territory is less broken by hills and mountains, which present the disadvantages of steep grades and which are usually associated with a sparsely settled country. In some of the larger cities, it is true, several electric railways have been built and are in operation, some of them embodying the latest ideas in electric work, but there are many localities, especially where large distilleries abound, where "rapid transit" is obtained only by the labor of horses or mules. The "Blue Grass" section of the state contains the larger portion of these whisky distilleries, and until recently little or no attention has been paid to the possibilities of transporting their output or supplies by such a motive power as electricity. The principal idea in locating a distillery seems to have been to build it in close proximity to a pure and sufficient supply of limestone spring water, this being one of the reasons for the famous reputation for the output of superior whiskies which this region has attained. The first place to realize and profit by the advantages to be gained by electric traction is Frankfort. This city possesses a population of about 10,000 inhabitants, is the capital of the state, numbers numerous manufacturing establishments and is so situated that it covers a large area, making the four miles of track used for passengers quite profitable, in addition to which the management has a park containing about 40 acres, situated on an elevation of about 500 feet overlooking the city and the Kentucky river.

The primary object of the Capital railway was, however, the hauling of grain, coal and wood to the distilleries and carrying their output of whiskies to the steam railroad connections. From the group of pictures upon this page an idea may be gained of the diversity of the work done by the road, Fig. 1 illustrating a motor car alone, used as a sort of an express and light freight car, Fig. 2 representing a motor car hauling a train of box-cars around a curve, while in Fig. 3 is shown one of the passenger cars. The closed passenger cars are 18 feet long and are handsomely finished. They are equipped with 25 horse power motors and are intended to haul trailers. The freight motor car is of a special design, 28 feet in length, and are mounted upon a pair of heavy trucks with five-foot wheel bases. The body is built extra heavy to withstand the severe strain of having loaded freight cars as trailers. In appearance it is very much like an ordinary baggage car as used on steam roads. Four 25 horse power motors, controlled by a single specially designed controller, are attached to each of the four axles, making each a driver. The total weight when empty of this car and equipment is 15 tons, and when not used for hauling full loads is used for handling small shipments, barrels and boxes.

The power house is a large, solid brick building, 52 by 125 feet, with a double track car barn, 26 by 125 feet, attached. The boiler room, which is separated from the engine-room by a brick partition, is 35 by 52 feet, and contains a boiler plant of 200 horse power capacity, with heater, boiler, feed pumps, etc. The engine and dynamo room, a view of which is presented in Fig. 4, contains two 100 horse power Jenney street railway generators, belt driven by one of the latest type Dick & Church tandem compound engines of 200 horse power capacity. The switchboard shown in this illustration is of the improved Jenney type of marble panels. The instruments are of Weston make and all connections are made upon the rear of the board. The electrical station equipment was furnished and installed by the Jenney Electric Motor company of Indianapolis, which has a Chicago office under the management of A. H. Goode. The track is of 56 pound T rail laid on white oak ties two feet between centers and ballasted with crushed blue limestone rock. Heavy cuts and fills are numerous, the nature of the country through which the road runs being very mountainous and the grades very severe, reaching in some instances as heavy as eight per cent., and in one instance a reverse curve was necessary on a seven per cent. grade. The overhead line is of the Creaghead flexible side bracket construction, especially made for high speed roads in the suburbs. In the city the side pole and span wire construction, employing No. 0 trolley wire, is used.



FIGS. 1, 2 AND 3. PASSENGER AND FREIGHT ELECTRIC ROAD IN KENTUCKY.

Additions to the University of Rochester Laboratory.

The University of Rochester, N. Y., has for some time been equipped with a fine chemical laboratory, and it is now the intention of the trustees to enlarge the course in physics and include a thorough course in electricity and magnetism. For this purpose a large quantity of apparatus will be needed, and provision has already been made for a large projection lantern with arc light, and Edison

terminals have been ordered for experimental work. It is also the intention to have electric power installed in the laboratory to run machinery and to have a shop to enable the students to manufacture their own tools. Other apparatus will be purchased, and it is expected that by next fall many of the improvements will have been made. The laboratory is a fine stone building fronting on the athletic grounds and contains enough room to provide for one of the largest institutions of its kind in New York state. These additions to the physical course are to be made under the supervision of Mr. Lawrence, who was for two years connected with the Cornell laboratory and previous to that was in the Columbia laboratory. He consequently has a thorough knowledge of what is necessary to be done and will be given full power to make all changes he deems necessary.

New Two-phase Alternating System of Electrical Distribution.

It cannot be doubted that the commercial introduction of the new two-phase alternating current system of the Stanley Electric Manufacturing company is an event of much importance to the electrical world. The gentlemen who have perfected this apparatus—William Stanley, John F. Kelly and C. C. Chesney—have been engaged in the work for the last two years, and the electrical fraternity has, in a measure, been made acquainted with the results obtained by them, so that the system is not entirely unfamiliar. The Stanley company, composed of conservative business men with ample capital, determined to make sure of every point, however, before placing the new machinery on the market, with the result that the system is but now offered to the public, not as an experiment, but as an assured success. The two-phase generators and motors were exhibited last summer at the World's Fair, where they attracted much attention from electrical men. A brief description of the exhibit was given in the WESTERN ELECTRICIAN of July 1, 1893. The system has also been tested in practical operation in several places in the East, and appears to have given entire satisfaction in each instance. All of this two-phase alternating apparatus is marked with the initials of the three electricians that developed it, "S K. C." The three gentlemen thus distinguished are all well known for their work with the alternating current. Mr. Stanley, in particular, may be mentioned for his important connection with the Westinghouse system and for the new ideas embodied in the widely known transformer bearing his name. He and his associates set themselves the task of devising an alternating current system of electrical generation, transmission and utilization which could be used alike for arc or incandescent lighting or for power, and also on currents of the same frequency as existing alternating current lighting circuits. It is believed that in the two-phase apparatus, illustrated by the accompanying pictures, the inventors have satisfied these exacting requirements.

The two-phase system is the simplest form of the multiphase idea of power transmission by alternating current. By eliminating the heavy false currents that have so seriously interfered with the regulation of the ordinary single phase alternating motors, the Stanley company is enabled to operate its motors on circuits carrying high frequency currents, running up to 16,000 alternations per minute. Indeed, the company announces the rule to be: "Keep the frequency as high as the local conditions will permit in order to obtain the most economical operation and at the same time render satisfactory service to customers." It is asserted that frequencies of 6,000 alternations and less are to be avoided, as they necessarily increase either the cost or the leakage current of transformers.

A general view of the large 240 kilowatt generator is given in Fig. 1. The revolving part, consisting of the field or inductor, is shown apart in Fig. 2, while Fig. 3 represents the stationary armature coils. This machine, although based on the not easily comprehended principles of alternate current operation, is simple in construction. One striking feature is the absence of moving wire. The inductor, Fig. 2, is made of a steel casting, upon the periphery of which polar projections of iron laminæ are securely fastened. There is no wire whatever on this inductor, and consequently there is no necessity for insulation and no use for a collector. It is simply a mass of metal which can be put in place and revolved with a feeling of perfect certainty that nothing can happen to it. The machine is massive and strong in construction, the body of it, Fig. 3, being the stationary armature. As will be seen, the individual coils are very small, are wound separately on forms and then secured in grooves provided for them in the laminations. Being so small and stationary, it is a comparatively simple matter to insulate them to safely withstand high voltages. If a coil should be destroyed by lightning or any other cause, it can be readily replaced by the ordinary men employed about the station. To facilitate the removal of armature coils the side-tables shown in Fig. 1 are employed. By turning the hand-screws on each side all the armature coils can be exposed without disturbing the inductor. The side-tables are removable and can be taken away when not needed. This feature is a great convenience, and one which all practical men will appreciate. The armature and field wires are brought out from the machine to a terminal board shown in Fig. 1, and from this terminal board the leads are taken out. With this arrangement no wires of any kind are festooned about the machine. The terminal board consists of two heavy slabs of marble, one secured to the machine and the other forming a removable cover. This cover on its inner face is divided into partitions so that, when in place, each terminal is in a compartment by itself. It is so arranged that fuses may be inserted in the leads, if desired, as an extra precaution against short-circuits. This neat and convenient arrangement is made possible by the entire absence of collector or commutator. By simply changing the connections on this terminal board the armature coils may be connected either in series or parallel, so that the standard machines may be connected for either 1,000 or 2,000 volts, as desired. The field or exciting coil is circular and wound on a copper spool, which rests in the center of the machine surrounding the inductor. Constructed in this way it is easily insulated to a very high degree, and being enclosed on three sides by the heavy copper spool, danger of breaking down of the insulation due to a discharge, caused by a breaking of the field circuit when it is fully charged, is practically removed.

FIG. 4. PASSENGER AND FREIGHT ELECTRIC ROAD IN KENTUCKY.

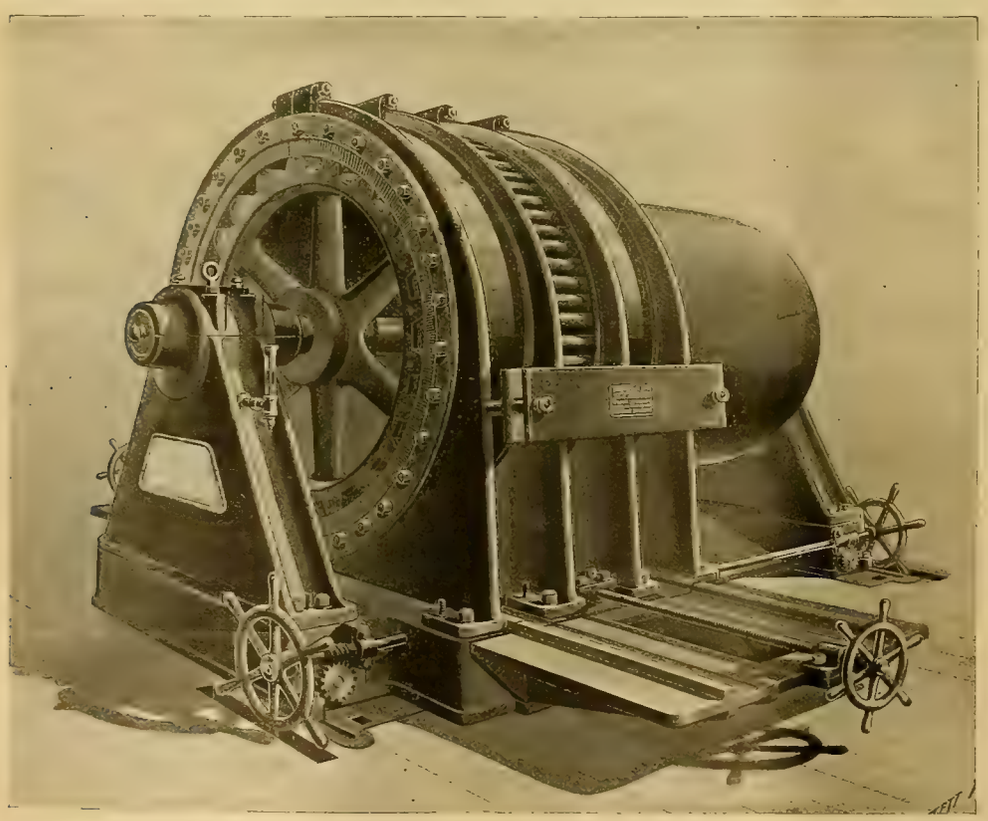


FIG. 1. NEW TWO PHASE SYSTEM.—240 KILOWATT GENERATOR.

Some of the advantages claimed for the two-phase alternator are: High efficiency, averaging 95 per cent. at full load; economy in excitation; the absence of moving wires, removing all solicitude about the moving part; abundant ventilation; close regulation, it being claimed that the full load, excepting one lamp, can be thrown off instantly without materially increasing the brilliancy of the one remaining lamp (provided, of course, the speed of the machine is constant), and this is accomplished without any extraneous regulating device; slow speed; absence of commutator or collector; the generation of a correct current wave, and ease of repairing. The 240 kilowatt machine shown in Fig. 1 is operated at 400 revolutions per minute, is 13 feet 3 inches long, 7 feet 10 inches wide, 7 feet 6 inches high, and weighs 28,000 pounds.

The Stanley two-phase motor is shown in Fig. 4, with the armature detached in Fig. 5 and the field in Fig. 6. No one in the electrical business need be told of the importance of a practicable commercial alternating current motor. It is claimed for the "S. K. C." motor that it fulfills every requirement. It may be best described as consisting of two parts, a motor proper and a rotating transformer, the two parts alternately exchanging their functions. It consists electrically of two fields, which are fed by currents differing 90° in phase, and two armatures, though mechanically there is but one, as shown by the

cuts. The winding is so connected that the wire which lies directly under poles on one armature is in series with the wire lying between poles on the other. It is clear that in this position one-half the machine acts as transformer and the other half as motor. The armature winding is not connected with the circuit and consequently the only current flowing in it is an induced current. The field construc-

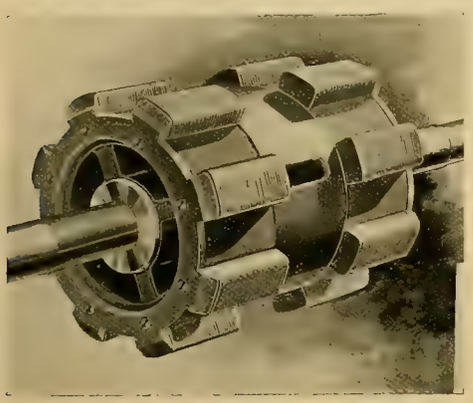


FIG. 2. NEW TWO-PHASE SYSTEM.—GENERATOR INDUCTOR.

tion is shown in Fig. 6. The coils are wound separately and then secured in place. These coils are the only part of the motor connected with the circuit. Being stationary they are easily insulated to a high degree. The applied electromotive force on the coils is 500 volts. By what is termed the "compensating winding," which consists of short-circuited coils of high conductivity placed in the field poles for the purpose of neutralizing the self-induction of

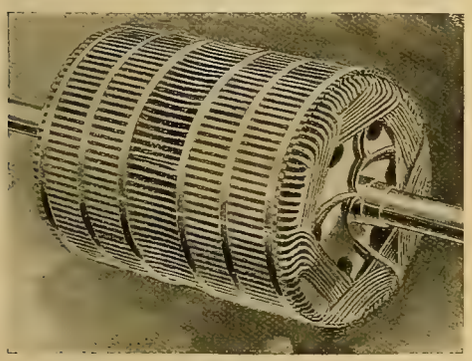


FIG. 5. NEW TWO-PHASE SYSTEM.—MOTOR ARMATURE.

the armature, the starting torque of the motors is increased, so that, in the standard motors of different sizes, at starting, a torque is obtained which varies from 50 to 200 per cent. greater than the running torque at full load. This is an ingenious invention and one of great importance in induction motors and is covered by a broad patent issued to Messrs. Stanley and Kelly. The most unique and striking feature of this motor system is the use of the condenser.

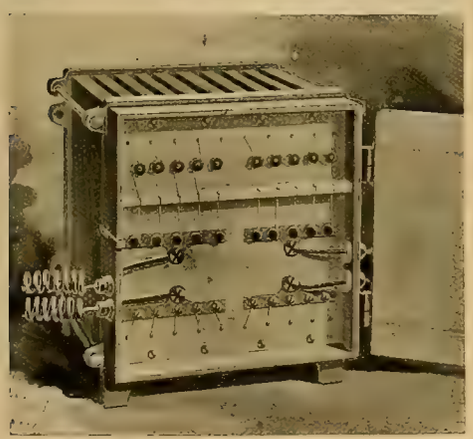
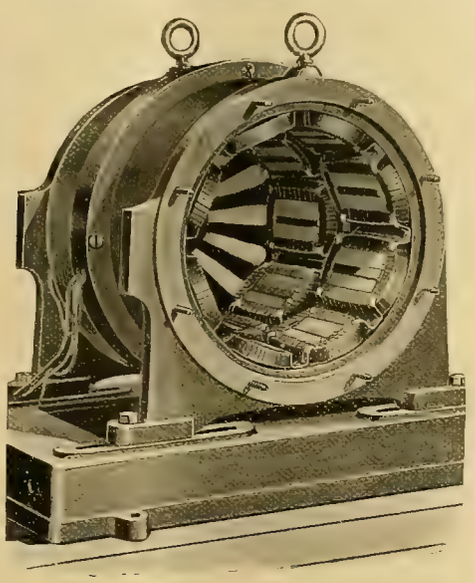


FIG. 7. NEW TWO-PHASE SYSTEM.—CONDENSER.

The function of the condenser is to make the motor take current in proportion to its load substantially as direct current motors do, and it is said to accomplish the result so perfectly as to make commercial what has heretofore been only experimental. A condenser with cover thrown back is shown in Fig. 7. The condensers are connected in multiple with the fields of the motor. When so placed they supply the lagging component of the current, or, in other words, the false current. Thus, with this arrangement, the false currents, instead of flowing back through the transformer line and generator, thereby disturbing the whole system, simply flow in a local circuit through the condensers. This renders it possible to operate alternating current motors and lights successfully from the same generator and circuit. Without condensers it is claimed that alternating current motors cannot be operated on the same circuit with lights on currents of high enough frequencies to meet other commercial conditions. With them motors can be operated on circuits of 15,000 or 16,000 alternations. The motors have about the same efficiency as direct current motors, and are said to regulate within from 6 to 10 per cent.

The starting box is on the motor, as shown in Fig. 4.



F G. 6. NEW TWO-PHASE SYSTEM.—MOTOR FIELD.

When the switch is closed to start the motor, the handle of this box is at the left hand when facing it, and as the motor reaches its full speed it is thrown clear over to the right. When in this position the resistance in the box is cut out, so that it is in circuit only for a moment when starting. The collector on the motor is for the purpose of putting the resistance in this box in circuit with the armature when starting, and when the motor is up to speed and the resistance cut out it performs no further function. The motors are neat and compact in appearance, and are claimed to be simpler, less liable to damage, and to require much less attention than direct current motors. As

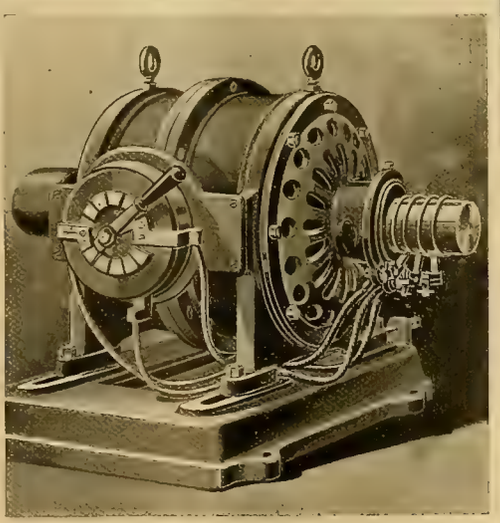


FIG. 4. NEW TWO-PHASE SYSTEM.—MOTOR, SHOWING STARTING SWITCH.

there is no commutator there is no danger of fire from sparking, so that it is unnecessary to box up the machines to prevent contact with inflammable material.

In introducing this new system to public notice the company guarantees that the service of lights from the two-phase system under the usual conditions of operation, with motors and lights on the same generator and circuit, will be as satisfactory as light service from the ordinary single phase system on which no motors are used, provided the engineering conditions as to steadiness of power, loss in line, etc., are the same.

This is certainly a most desirable consummation, and ought to result in a greatly increased sale of electrical power where alternating current is used.

Some Storage Battery Phenomena.[1]

By W. W. Griscom.

The study of a complete curve of discharge of a storage battery discloses three rather sharply defined changes in potential difference, and after allowing for the effect of internal resistance, we find that the changes are those of the electromotive force.

What is the reason for these changes? Which plate is responsible for them?

A microscopic examination of the negative (spongy lead) plate disclosed metallic lead and what appeared to be one or possibly two sulphates. The positive (peroxide) plate, however, showed spongiform crystals of very dark color, known as electrolytic peroxide; other comparatively large crystals of brilliant red, probably Frankland's red sulphate; others of yellow, probably yellow sulphate; and finally the better known white sulphate of lead.

The production of these diverse chemical forms must be attended by production of diverse potentials, and the electromotive force of the battery is possibly a resultant with one or more chemical reactions predominating at various parts of the charge and discharge.

That there should be any change of electromotive force during the charge or discharge of the battery shows the complexity of the chemical actions, and as the changes are at times sudden, and at times gradual, uniform and invariable, it would seem to point to the conception that the electromotive force is the resultant of three or more sets of chemical actions.

The material on the charged positive plate of the battery is commonly called peroxide of lead, but it certainly differs from it both in its ability to generate electromotive force and in its appearance, and Fitzgerald has pointed out that

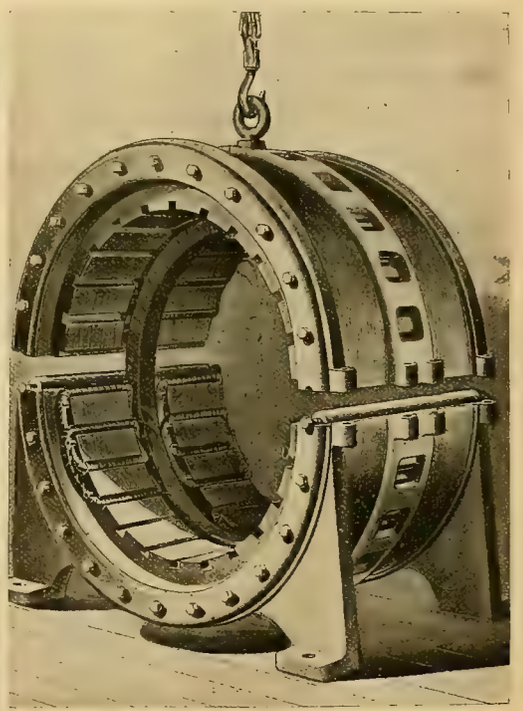


FIG. 3. NEW TWO-PHASE SYSTEM.—STATIONARY ARMATURE OF GENERATOR.

its composition corresponds to the hydrated peroxide of lead, $H_2Pb_2O_5$. He further intimates that a higher oxide of lead may be present, such as perplumbic acid, $H_2Pb_2O_7$. McLeod has told us how peroxide of hydrogen, ozone and persulphuric acid are produced. Then there are the two new sulphates of lead. With this array of chemical products to assist our imagination, the wonderful curves of electromotive force of a storage battery on charge and discharge become comprehensible. And the fact observed by Gladstone and Tribe that 34 per cent. more of oxygen was absorbed by the positive plate than could be accounted for by the production of PbO_2 becomes explicable. It has probably been used in converting $H_2Pb_2O_5$ into $H_2Pb_2O_7$. Their suggestion that it was absorbed by local action between the grid and the peroxide during charge is utterly untenable. There is no such action. And if there were the grid would not last through a dozen charges.

The conversion of $H_2Pb_2O_5$ into $H_2Pb_2O_7$ would account for the abnormal rise of electromotive force at the end of charge, and if it be assumed that the $H_2Pb_2O_7$ is not stable but yields ozone gradually, thus accounting for the odor of a freshly charged positive plate, it would account for the steady fall of electromotive force on interrupting the charging current. The chemist will easily see relation between these reactions and the presence of peroxide of hydrogen and the continual evolution of oxygen from the positive plate, and the fact that a charged cell gradually loses its charge, maintaining for days a higher temperature than the air.

I am sorry that the time allotted me for the preparation of this paper did not admit of the preparation of curves showing the differences in temperature between certain plates of a cell and even between different parts of the same plate. Of course these changes, many of them, are

1. Read before the American Institute of Electrical Engineers, Philadelphia, May 16, 1894.

very minute, and they are due to at least two causes, viz., the liberation or combination of sulphuric acid on the one hand, and C_2R on the other.

In order to study the progressive changes on either plates and to plot them out in a curve, it is merely necessary to choose a substance which produces a measurable electromotive force with the plates, independently of the electromotive force which is being produced by the two plates appertaining to the battery, but this substance must be one which is neither modified by the electrolyte nor by the minute current which it is required to produce for the voltmeter. The last is of more consequence than is generally understood, as a storage battery which has been overdischarged and which has been allowed to recuperate will, even if it be of large size, say of 350 ampere hours' capacity, produce a deflection on a Weston voltmeter (of about

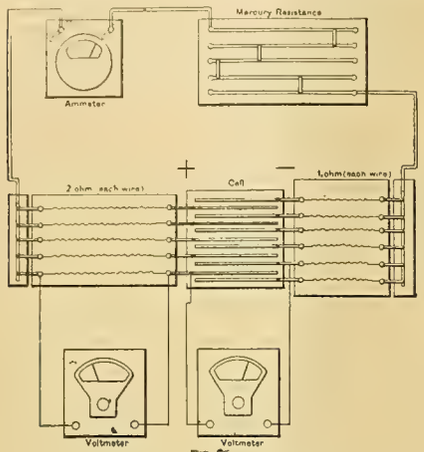


FIG. 1. SOME STORAGE BATTERY PHENOMENA.

300 ohms), which at first may be 1 75-100 volts and which will immediately begin to fall with a velocity quite appreciable to the eye. Many substances have been tried for such a test plate, as for example, zinc, carbon, platinum and copper, but nothing seems to be better than a well charged Faure or Plante couple of considerable dimensions. The use of such plates was first published by Mr. Crompton, although they have been used for years in my laboratories, and give concordant results.

It might be desirable, but it is not necessary, to ascertain accurately the exact fraction of the total electromotive force which is due to the plate under test. It is important, however, to know the rate of its change of electromotive force while the cell of which it forms an individual part is discharging or charging.

Referring to Fig. 2, it will be observed that the negative plate maintains a nearly horizontal line, until the potential difference of the couple on discharge has fallen to 1.9 volts, while the positive plate maintains a curve almost parallel to that of the cell, showing that the characteristic curve on discharge of a storage battery with plates of nearly equal capacity is due mainly to the reaction in the positive plate.

At the end of the charge, however, the characteristic curve of electromotive force is due to the negative, the rapid rise of its curve being nearly parallel to that of the battery, while the rise of potential of the positive is nearly a straight line, which, however, is gradually rising.

It should be noted that this curve is the true electromotive force and is not dependent on the internal resistance of the cell, which reaches the maximum shortly after the fourteenth hour in this case, and remains quite constant during the remaining seven hours of the charge. But while the electromotive force is not dependent on the internal resistance, the sudden changes in each curve are usually simultaneous, indicating a common cause.

It may be considered proven, therefore, that in a storage battery with plates of nearly equal capacity the changes in the positive plate determine the characteristic curves of potential on discharge, and that the changes in the negative plate determine the characteristic curves of potential at the end of the charge.

A curious feature in charge is the intersecting of the curves of the positive and negative plates at several different points. At the beginning of charge, the two plates are at nearly the same potential, the positive potential rises rapidly until it reaches 2.22 volts, when it begins to rise in a straight line strictly proportional to time. The negative, on the other hand, rises gradually until it reaches 2.18 volts; then it rises rapidly, intersecting the positive curve in 14⅛ hours and at 2.24 volts, and continuing to rise until it reaches 2.40 volts in 16¾ hours, whereafter it remains constant for the five hours which the positive requires to reach the same potential.

To trace the history of a negative during discharge, it fell in five minutes .135 volt, in the next six hours, .035 volt, in the following hour .250 volt and in 15 minutes more 1.500 volts, showing less capacity than the positive plate. In half an hour after stopping discharge it recovered to 1.9 volts—jumping instantly on charge to 2.08 volts, and in 12 hours of charge arose only .05 volt. Of course the rate will not modify the general characteristics of the curve.

Within the working limits of charge or discharge, the negative did not vary over 2 per cent. of potential difference.

The history of the positive in this curve is not so satisfactory. Falling rapidly to 2.04 in ten minutes, it fell thereafter in a gradual curve .115 volt during the normal time of charge, a fluctuation of about 6 per cent. Ultimately the positive shows more capacity than the negative.

The total fluctuation of the cell during the six hours after the first five minutes was 6 per cent. in discharge down to 1.9 volts. This was the fluctuation of the potential difference, that is to say it was the fluctuation which would be noticeable to the engineer in practical service and included all changes due to internal resistance.

The usual construction of storage batteries—all the plates of one name being permanently fastened to one heavy conductor—has heretofore interfered with the study of the individual plates of a cell. To the end, therefore, of facilitating this investigation, the author constructed some cells with independent plates, connecting all those of one name to a common mercury trough, either directly or through intermediate resistances, as in Fig. 1.

The resistances were made such that one ampere would give ten divisions on a dead-beat galvanometer, and as each division could be divided by the eye into tenths, the current passing could be read within one-hundredth of an ampere. An independent ammeter and an adjustable mercury resistance were inserted and the total current kept constant. The cells tested in this way were of three types. The pasted cell of the Accumulator company, the chloride cell and the Plante cell. The object in testing a chloride cell was to ascertain whether the exceedingly good contact produced by casting the grid around the active material while the latter was hard, and allowing the molten metal to contract upon it, would operate to lessen the somewhat remarkable variations in the behavior of all storage battery plates, but this was not the case. Neither was there any marked difference in the behavior of the Plante cell.

The accompanying characteristic readings were obtained from the three types of cells at their normal discharging rates.

PASTED CELL.

AT START.		8 HOURS AFTER START.	
Amperes.	Volts.	Amperes.	Volts.
6 00	2 035	6 00	1·27
5 93	2 025	6 15	1 79
5 90	2 024	6 125	1 795
5 80	2 021	6 05	1 78
5 97	2 025	6 025	1 78
5 92	2 09	5 85	1 74
5 95	2.092	6 10	1 80

[illegible]

	AT START.		1 HOUR AFTER START		2 HOURS AFTER START		3 HOURS AFTER START		6 HOURS AFTER START	
	Amp	Volts	Amp	Volts	Amp	Volts	Amp	Volts	Amp	Volts
1	4 73	2 00	4 77	1 995	4 77	1 99	4 70	1 965	4 67	1 00
2	4 77		4 77		4 71		4 71		4 64	
3	4 71		4 71		4 70		4 70		4 73	
4	4 60	1 93	4 71	1 99	4 70	1 985	4 69	1 955	4 67	1 90
5	4 71		4 70		4 69		4 63		4 42	1 85
6	4 73		4 74		4 77		4 70		4 91	
7	4 75	1 005	4 77	2 003	4 74	1 995	4 81	1 985	4 98	1 056

CHLORIDE CELL.

	AT START		1 HOUR AFTER START.		3 HOURS AFTER START		4 HOURS. AFTER START		6 HOURS AFTER START.		8 HOURS AFTER START.		
Positive	Amp.	Volts.	Amp.	Volts	Amp.	Volts	Amp.	Volts.	Amp.	Volts	Amp	Volts.	Negative.
1	5·30	2 03 2.065	5·75	2 01 2.04	5·76	1 04 2 00	5 80	1 90 1.965	5.80	1.735 1.89	5 60	1.80 1.78	1 2
2	5·43	2 035 2.045	5·40	2 015 2.03	5·45	1 965 1 98	5·40	1.935 1.94	5 45	1.86 1.88	5 80	1 80 1.81	3 3
3	5 40	2 035 2 035	5·35	2 02 2 02	5 35	1·975 1.96	5 30	1 94 1 95	5·35	1 865 1.87	5.80	1 80 1 80	3 4
4	5 43	2 045 2.03	5 40	2 03 2 015	5 40	1 985 1 965	5·40	1·955 1 93	5 40	1.88 1 86	5 85	1.80 1 64	4 5
5	5·70	2.055 2.02	5.65	1 95 1.975	5 70	1 92 1 925	5 70	1 96 1 89	5·55	1 86 1.66	5 60	1 56 1 56	5 6

The curious phenomenon was presented of variations of current amounting to 30 per cent. in plates manufactured rigorously alike, kept in parallel and subjected to like treatment during their previous life. In cases where the discharge is pushed below 1 8 volts I have observed even more serious differences, amounting to a variation of 225 per cent., one reading being 2.8 amperes, another 6.4 amperes for perfectly good new plates carefully treated.

And perhaps a still more curious fact was the differences of electromotive force of the plates in the same cell discharging through equal resistances and connected finally in parallel to the same circuit—the electromotive force ranging from 1.60 volts to 1.85 volts for neighboring plates

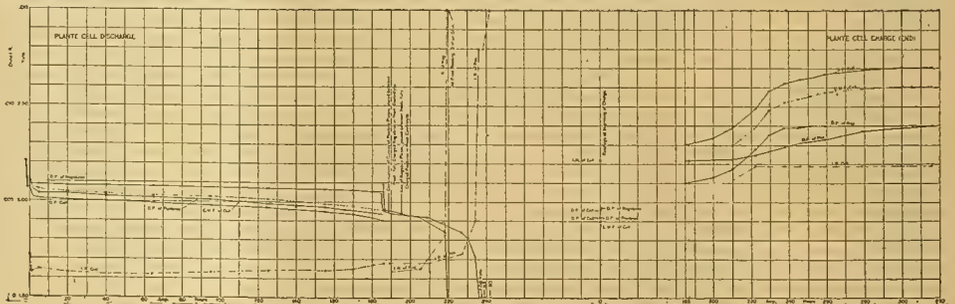


FIG. 2. SOME STORAGE BATTERY PHENOMENA.

in parallel in the same cell, at the same time. On interrupting the circuit at the end of the discharge of a cell, a considerable flow of current, as might be expected, passed from one plate into another, and it was hours before the batteries reached equilibrium after the external circuit was open.

The discharge of one positive into its neighbor was a rather unexpected result. It had been thought that if one plate had less capacity than its neighbor it would simply stop discharging at a certain point, but that its electromotive force would always be equal to that of its neighbors and that therefore no current would flow.

The explanation of the phenomenon appears to be that the deficient plate keeps on discharging at a lower rate than the perfect plate, and finally reaches a much lower point of discharge. On interrupting the current the plate which has not been discharged so far, rapidly recovers a higher voltage than its neighbor and, therefore, discharges into it.

This effect must also take place in the different parts of any one plate, and may be a cause for the formation of peroxide on the surface of a negative plate after a discharge, a phenomenon which I have never noticed, but which has been remarked by too many observers to be ignored.

The two outside negatives give more than their proportional amount of current on discharge, the current being actually less than on the other plates, the potential remains higher, and the discharge is therefore a little greater. This, in turn, affects the positives next to them and these positives are usually the first to disintegrate in a carefully used cell. This fact was most noticeable in batteries used on the Eckington and Soldiers' Home railway at Washington,

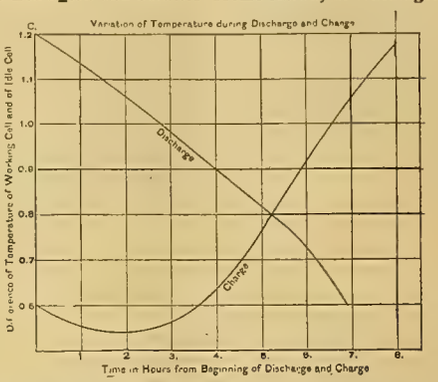


FIG. 5. SOME STORAGE BATTERY PHENOMENA.

where out of 20,000 positive plates there did not occur a single instance of buckling, and yet the outside positives always showed greater disintegration than the others.

The tendency of one part of a plate or one portion of peroxide to discharge faster or slower than its neighbor is one of the reasons which induced us to adopt the equipotential methods of connecting up the several plates of the storage battery. It is to be noted that these phenomena occur to a serious extent only when the batteries are discharged below 1.95 volts of potential difference per cell.

The foregoing tables afford the most complete proof of the irregularity of the chemical actions which produce the electromotive force of the battery. Now one plate is giving current, now another. And most remarkable of all, the different sides of the same plate exhibit differences of potential at their terminals which I can only attribute to differences of internal resistance, both in the electrolyte within the plates and in the porous active material itself.

The active material during charge and discharge is undergoing chemical change irregularly, not merely in the different plates, but in the different sides of the same plates, and as the active material is made up of large numbers of little pellets isolated from one another by the grid, the conclusion seems inevitable that one side of a given pellet is active to a different degree from the other side. It is not necessary to conceive that the electromotive force generated on one side of a pellet is as different from the electromotive force of the other side as would be indicated by the potential difference at the plate terminals. The more reasonable conception appears to be that the internal resistance of one side of a pellet is sometimes greater, sometimes less, than that of the other side, varying with the unequal chemical action. But I cannot escape the conclusion that there must be some real difference of potential and consequently local action—not merely between the parts of the grid, but between opposite sides of the same pellet or paste. This would account for the fact observed by Ayrton that a working cell is always above the temperature of the air, even when its own temperature is falling in discharge.

In 1890 Prof. Ayrton, in his most valuable contributions to storage battery literature independently noticed the fall of temperature in a discharging cell, and published a curve which is reproduced in Fig. 5.

The explanation for at least a part of this phenomenon is simple. If, as we all know, the addition of sulphuric acid to water raises the temperature, it is natural to infer that the removal of the acid from the water will lower the temperature. The former occurs on charge, the latter on discharge.

This fall of temperature on discharge was first brought to my attention in 1887, when some of the cells of the Julien cars on Fourth avenue, New York, were reported to heat unduly, and the explanation offered was that they were called on for increased currents on certain grades

with unfavorable conditions of the tracks. As some of the cells did not heat, I was not satisfied with the explanation, especially as the resistance of the cells, about .002 ohm, would only account for about 1 1-4 heat units even on 100 amperes discharge. I then investigated the question and found that the temperature actually fell even with heavy current, when the cells were in good order.

The potential of a cell is partly due to the degree of charge of the positive and partly to that of the negative and partly to the electrolyte. If a negative plate, taken from a fully charged cell indicating say 2.65 volts on the normal charging current, is coupled with a positive from a partly discharged cell, indicating say 1.9 volts on its normal discharge current, the electromotive force of the combination will lie between the two. If the couple be removed to a stronger or weaker electrolyte, the electromotive force will rise or fall accordingly. So that a measurement of the potential difference at the terminals of the cell is not an infallible indication of its condition of charge. If both plates are equally charged, the indication is most useful, but when, as frequently happens in actual service, one plate is further discharged than the other the potential difference is deceptive.

The variations of specific gravity of the electrolyte are practically proportional to the ampere hours of useful charge or discharge—barring local action, short-circuiting, change of temperature and a gradual sulphating of discharged positives when idle.

The variations of the internal resistance of a cell afford a valuable indication of the condition of its active material, and therefore of its degree of charge. These variations have been attributed to the varying poros-

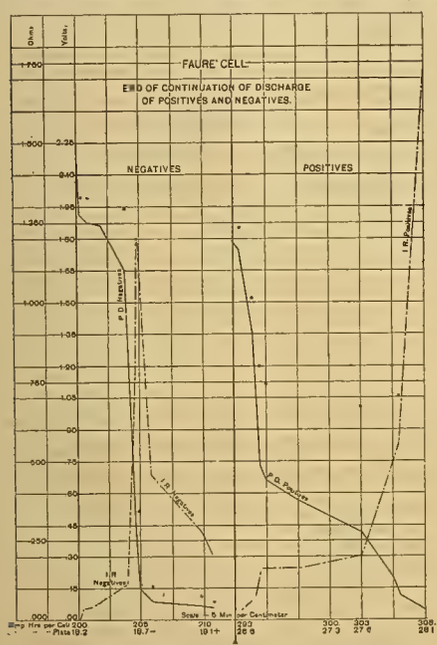


FIG. 4. SOME STORAGE BATTERY PHENOMENA.

ity of the active material—the electrolyte becoming more and more excluded as the pores become clogged. But this explanation does not account for the odd but invariable nature of the characteristic curves of the internal resistance. If this were the true explanation, why does the curve fall rapidly in the early part of the discharge instead of rising? Why should it remain constant for the greater part of the useful discharge? Why should it suddenly rise to a great degree, and then fall in the middle of a prolonged charge? Why is the internal resistance less instead of more on a higher rate of discharge? These facts are not easily reconcilable with the clogging theory, and our knowledge of the chemical reaction is not sufficient as yet to affort a convincing explanation.

Experience shows that it adds greatly to the life of a cell and brings other advantages to stop the charge at between 2 3 and 2.45 volts, and to stop the discharge at 1.90 or 1 95 volts, while a comparison of the accompanying curves of a cell will show that these potentials are reached shortly before or during a sudden rise of the internal resistance.

A very curious misapprehension prevails among some battery people, in spite of the airing the subject has again and again received, to the effect that the negative plate has more capacity than the positive. If a cell be discharged at a high rate to 1.88 volts, for example, the positive plate will show a much lower potential than the negative and might therefore be deemed to be more discharged. If then the negative element be transferred to a freshly charged positive element, the negative will usually show a considerable additional capacity, and this has been cited as a proof of the erroneous statement. But if the positive be similarly treated, it usually shows considerably greater capacity than the negative. This is especially the case with the Faure cell in which the positive actually has 25 per cent. more volume of active material than the negative, and shows 45 per cent. more capacity; and is even so on a Plante negative, which has as much active material as the positive, and yet the latter has nearly 10 per cent. more capacity.

The positive plate is usually made of greater capacity than the negative in order to prevent it from ever becoming discharged, to allow for its gradual loss of active material, but there are grounds for doubting the propriety of so doing. A negative plate ought never to be discharged so far as to drop after the first ten minutes more than 1 or 2 per cent. in voltage, yet the temptation to do so with 45 per cent. excess of capacity in the positive is very great—with the result of causing shrinkage of the negative paste and a serious loss of capacity in the cell.

There is another action which goes on in storage batteries, and presumably in other forms of electrolyte chemistry, which I have not seen explained, nor in fact described. When the chemical reactions in an electrolytic cell are simple, as, for example, decomposing sulphate of copper or sulphate of zinc, the amount of action is proportional to the ampere hours. But when the possible chemical reactions are complex, as in a storage battery, the changes are governed by the potential difference, as well as by the current, probably because one of the components requires a different electromotive force to break it up from that required by another. A curious result ensues. Perhaps the current governs the amount of chemical action and the potential the kind. Our factory department reports that if a plate pasted with red oxide of lead is opposed to a plain lead grid in a "forming" bath, the formation of peroxide proceeds evenly and uniformly in the well-known way. If it be opposed to a pasted negative the same result follows. But if it be opposed by another positive plate, a different action ensues and the unformed plate cannot be properly converted to peroxide until the other positive has been completely reversed, and converted into a negative, thus raising the potential difference of the cell. In the curve of the Faure cell it will be noted that at the time the potential of the piles suddenly rises, due to the sudden increase of the potential of the negative plate, there is at the same time a sudden increase of the internal resistance of that plate. This is, however, accompanied by a sudden and apparently sympathetic perturbation of the internal resistance of the positive plate, showing that some chemical change occurred in it, quite different from the usual action. This perturbation ceased as soon as the negative potential ceased to rise.

There are two other phenomena to which I will refer briefly in the hope that some members may be able to throw some light on their cause, viz: The sudden spontaneous discharge of a fully charged positive, and the tendency to buckle away from the light, *i. e.*, with a concave face toward the light. Wherever the tendency to buckle is great, as in treating Plante plates in some of the more rapid methods, I have observed that when a single positive is suspended freely a great distance from a negative in the center of a large jar, the buckling is invariably away from sunlight. The plate may be turned around, it may be moved quite close to one negative or the other, yet the buckling repeats itself invariably from the light. The plate may be straightened as you will, it may be left with a slight curve in the other direction, yet neither the natural differences of tension in the two sides of the plate nor the increase or diminution of electrolytic action on either side has any influence in buckling compared, apparently with the action of direct sunlight.

It will be remembered that Prof. Ayrton, in one of his valuable contributions to storage battery literature, commented on the theory of Mr. Crompton regarding the effect of light on the sulphating of the negative plate, and detailed an interesting experiment, which, although not conclusive, tended rather to confute this theory. Sir David Salomons remarked upon the effect of light on the glass cells, causing them, he said, to crack. Altogether it would seem that storage batteries are devices which engineers would do well to keep in the dark.

The automatic discharge of the positive plate is a comparatively rare phenomenon. In my experience I have secured accurate data in only three instances. I am under the impression that Sir David Salomons, when by his courtesy I was enabled to examine his splendid private plant in 1886, mentioned this phenomenon, but I do not find it described in his book, and as it may not have recurred in his experience he may have felt some hesitancy in publishing it.

On one occasion a cell was reversed experimentally, and the reversing charge continued until 470 ampere hours or three times the normal capacity of the cell had been passed through it. The potential attained 2.41 volts on a low charging rate. The positive had the healthy dark color of electrolytic peroxide of lead and was freely gasing, showing that it was as fully charged as possible. The charging current was interrupted and the electromotive force fell gradually to 2.12 volts in a perfectly normal way. In 35 minutes a curious seething sound attracted my attention to the battery, and I found it in a state of violent, almost explosive ebullition. The gas given off was pure oxygen in immense quantities. The temperature at the bottom of the cell had risen from 68° F. to 85° F., and at the top of the cell it reached 109° F. Fifteen minutes later the cell was quiescent, the voltage had fallen to .84 and the specific gravity from 1.157 to 1.123—the lowest point which it had reached 470 ampere hours before. Two or three days later the electromotive force was zero.

During the progress of the phenomenon and afterward the cell was examined carefully with the most minute care for any defect, short-circuit, or other irregularity and it was found to be in perfect order. A further charge of 876 ampere hours or about six times the normal capacity was given at a normal rate. On this charge as well as on the first reversal charge another curious effect was observed—the voltage rose in 15 minutes from zero to 0.18; in one minute more it jumped to 2.63. It then gradually fell to 2.01 in about seven hours and thereafter gradually rose to 2.48. The discharge was normal to 148 ampere hours and presented a peculiarity of a fully charged cell, that is to say, the electromotive force fell in two minutes from 2.05 on 30 amperes to 1.935 and then rose in a few minutes more to 1.94 volts, and then gradually fell the usual way.

Here, then, is the story of a complete automatic discharge of positive plates from the beginning of the preceding charge to the end of the following normal discharge. Was it because the peroxide formed only to a certain depth in a spongy lead and so densely as to exclude the electrolytes for a time, so that when the liquid at last penetrated the spongy lead a violent local action ensued? This would account for the heat, and for the fall of potential and of specific gravity, but would it account for the liberation of immense volumes of oxygen? I have frequently noticed the presence of considerable quantities of peroxide of hydrogen in electrolytes. Gladstone and

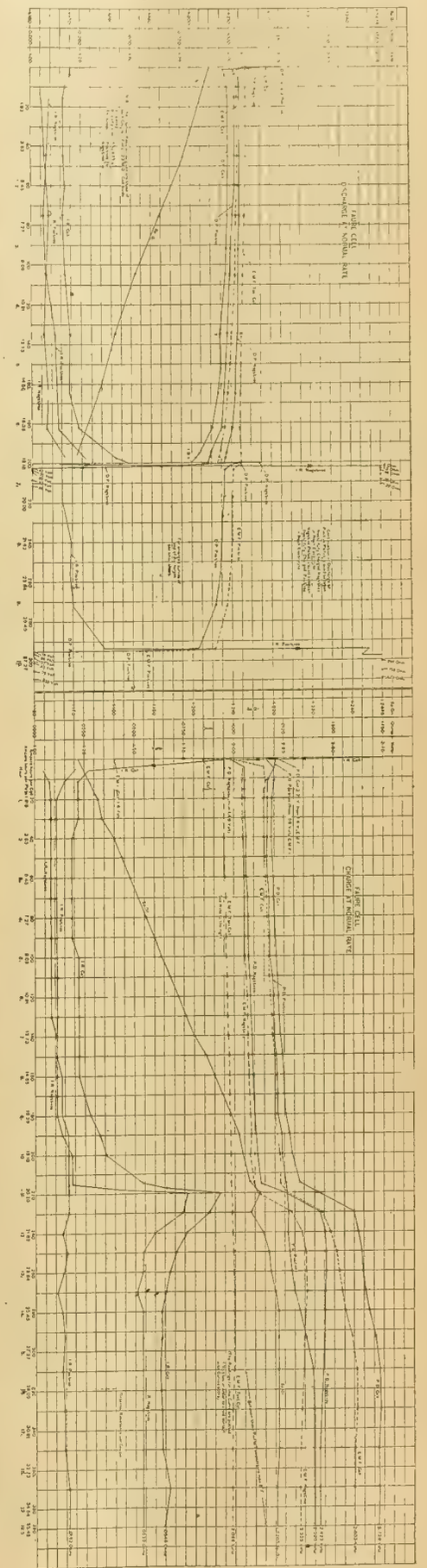


FIG. 3. SOME STORAGE BATTERY PHENOMENA.

Tribe have also remarked this substance, but intimate that they found it in minute quantities only. In some cases, however, I have observed it in very considerable amounts. Is it possible that this substance was present and exercised its well known property of liberating one atom of oxygen from peroxide of lead and another atom of its own oxygen at the same time? This would account

[*Continued on page* 299.]

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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RATHER an odd suit for damages which has been pending between W. H. Peck and the Marietta & North Georgia Railroad company in the United States court at Chattanooga has just been decided in favor of the railroad company. Peck was the station agent on the Marietta and North Georgia road and also acted in the capacity of telegraph operator. The company removed the telegraph instruments from the office, wishing to abolish it, but left wires running into the building. One day when Mr. Peck and his wife were seated in the office a thunder storm suddenly came up. There was a flash of lightning and Peck knew no more for some time. When he came to his senses he found his wife beside him on the floor dead. He brought suit against the company for $25,000. In the opinion handed down it was held that the company was not liable.

WHEN, in discussing the electrolytic action of the earth return currents of electric railway systems several months ago, the WESTERN ELECTRICIAN called attention to the fact that the one effectual remedy at present known, and the one to which electric railway companies might be compelled to come, despite the drawbacks of increased expense and cumbersome overhead construction, was the use of the double-trolley system, some of our contemporaries were inclined to make merry at an expedient considered revolutionary and altogether impracticable. We observe, however, that as the subject is further discussed the double-trolley is coming to be more and more considered as the only certain promise of relief and as far preferable to a complicated system of metallic underground returns. The situation caused by the undoubted corrosion of buried pipes by the earth currents of single-trolley railways is a grave one—one that must be fairly met—and while we believe that all other practicable measures of relief should be tested before falling back on the double-trolley, the fact still remains that this last resort is coming into increasing prominence as a possibility of ultimate remedy.

ANNOUNCEMENT is made in the Chicago daily papers that an elaborate system of electric power transmission is under consideration, which will enable several large manufacturing concerns now located in this city to establish a manufacturing center near Waukegan. It is said that the factories to be removed employ more than 1,000 skilled hands regularly, and that other establishments are expected to join the movement. It is proposed to establish a large central station from which current for lighting the streets and factories and operating the machinery will be supplied. It is estimated that considerable saving can be effected by the adoption of this scheme and other advantages will be gained. The projectors of this enterprise are experienced business men and they say that they have been compelled to recognize the fact that down-town business property in Chicago has become too valuable for them to occupy, and that there is entailed upon them in its use larger interest and renting accounts than is justified, when it is considered that in suburbs the same freight facilities may be secured with much less cost for plant. They also realize that the wholesale and retail houses need all the room in the district unoccupied by office and public buildings, and that the street traffic necessary to the service of these interests hampers the traffic between factories, their warehouses and freight depots, to such an extent that these conditions make it necessary for certain lines of manufacturing enterprises, whose products are bulky, to seek other locations. In the project now under consideration a belt railroad, electrically operated, will connect near-by railroads, and this will afford the factories excellent facilities for handling their freight. Should the scheme prove successful it will doubtless be followed by many other concerns similarly situated in other large cities.

SOME of our English contemporaries are discussing the relation of technical writing and style of literary composition. We think that they are right in pleading for a more precise use of language and a greater elegance of style in the presentation of theories or facts bearing upon utilitarian subjects. It does not deduct from the scientific or practical value of any statement that the idea is clearly and gracefully expressed in attractive English. Many technical writers appear to think otherwise, however, and, by slovenly literary methods, repel the reader from the very articles or books, which, from the prosaic nature of the subjects, should be made as readable as possible. Why should not the man who writes a book on transformers, for instance, be as careful in the construction of his sentences and in the choice of words as he who creates a novel or brings out a volume of essays? A good literary style is nothing of which to be ashamed, and it will strengthen, not weaken, the deepest scientific treatise or the most practical hand-book. This truth is as justly applicable to the papers read before learned societies as to books; and articles of this character, frequently of but ephemeral value and usually prepared in haste, are but too often conspicious not only by a total disregard for literary style but by flagrant violation of the rules of grammar as well. If we could persuade the writers of this class of technical articles to exercise greater care in clothing their ideas in words, to the end that each paper, as a whole, might be clearly written, concise and well expressed, we feel sure that we would be conferring a great benefit on the readers of technical journals, while we are positive that we would remove a cause of much grief and tribulation to the editorial mind.

AN interesting and valuable paper upon the work and aims of the Underwriters' International Electric association was read by George P. Low at the eighteenth annual meeting of the Fire Underwriters' association of the Pacific coast, in the course of which he paid particular attention to the subject of inside wiring and made a strong plea for an improved system of interior wiring. Mr. Low said that "wires must, like gas-piping, be run behind plaster, between walls and beneath floors. And it is the wire so concealed that makes the mischief. It is thoroughly out of sight, and if it were nothing more than out of mind, no harm would come. From a fire standpoint, it is an absolute impossibility to satisfactorily inspect wiring that is concealed and inaccessible. By no known means may reliable information be derived that will carry with it the assurance that such concealed and inaccessible wiring presents no fire hazard. A visual examination alone will do that. Then I ask why not require that all concealed circuits be so placed that they may be rendered accessible for such visual examination as will warrant your inspector in assuring you at any time whether the wiring is safe. There is nothing visionary, nothing chimercial about this. It is fact, not fancy, and if a remedy so simple yet so positive is not worth the trial, then all talk of the enormous fire waste from the use of electric wiring becomes but prattle." The writer recommended two methods of interior wiring, the first of which contemplates the use of wooden mouldings, grooved wooden strips, that would amply protect the wires and keep the air from them. The second plan provides for laying wires when the building is constructed, using wire ways and making all wires, although concealed, easily accessible at all times. Attention is being constantly directed to the fire hazard of inferior wiring and it is pleasing to note the efforts that are being made to remedy the faults which experience has shown to exist and to provide specifications for a system of interior wiring which shall not be subject to many of the criticisms now made upon this class of work.

STORAGE batteries possess a peculiar attraction for the general public, and despite repeated failures and disappointments there are always to be found capitalists who are ready to invest in enterprises of this kind. It is true that many of them have found the accumulator an expensive luxury, largely due to the litigation in which all of the companies have been involved, while as a matter of fact the only persons who may be said to have been financially benefited by the storage battery are the attorneys conducting this litigation. But there is evidence that much excellent work in the way of experiment and investigation has been done and that considerable progress has been made in the development of an economical and reliable battery. A record of an important series of experiments, extending over a period of several years, in which many valuable discoveries were made, is presented in Mr. Griscom's paper on "Some Storage Battery Phenomena," which is published in this issue. It is not too much to say that this paper is one of the most valuable contributions to the literature of this subject and that it is by far the best article of the kind that has been published in several years. Everyone who is interested in storage batteries should read it carefully, for it is undoubtedly the result of much earnest study and honest endeavor to solve the difficult problem. There are few men who have had the experience with storage batteries that Mr. Griscom has, and much weight will be attached to his conclusions which are evidently the result of intelligent and honest research and experiment.

There is one point to which Mr. Griscom alludes which will appeal strongly to everyone familiar with the history of the accumulator in this country and abroad. It is the relative advancement that has been made in the application of the storage battery in Europe and America. It is conceded that in this particular branch of electrical work at least, Europe is far in advance of America, and the explanation offered by Mr. Griscom is that while in Europe storage batteries have almost always been an economical success, in this country they have been too often an economical failure. But this explanation needs further elaboration. According to Mr. Griscom the reason is that the European always demands a margin for safety, while the American, with less capital and keener competition, is tempted to sail too close to the wind. Experience teaches that "a storage battery continually worked to its commercial rating is an economical failure," while "a storage battery worked sufficiently within its capacity is invariably a commercial success." The force of this argument is apparent and it receives additional weight when one stops to consider the few notable exceptions to the rule of general failure in storage battery work in these country. In Chicago, for example, there are two first-class installations that have been in operation for several years and have proved thoroughly satisfactory, but in the installations ample provision was made for the "margin" which Mr. Griscom demands. It is to be hoped that this paper will revive interest in this work among those whose experience has been of a discouraging nature and that the suggestions which it contains will receive careful consideration.

Some Storage Battery Phenomena.

[*Continued from page* 297.]

for all the phenomena, but what accounts for the peroxide of hydrogen in such an enormous amount, and why does it not always discharge oxygen from the peroxide? And finally is it possible that the continuous evolution of oxygen on the positive plate while the cell is idle is sometimes due to the presence of peroxide of hydrogen in minute amounts, and not merely to what has been called local action? I trust some of the gentlemen present will enlighten us on this point.

Perhaps the most striking peculiarity about the modern storage battery is the diversity of opinion among professional electricians as to its utility and commercial value. Men of the highest rank as electricians and engineers are ranged on either side of the question. Men of affairs who have put them to a commercial test exhibit a like divergence of views. Men who have tried the storage battery for a year of two have written about it in the most flattering terms and have discarded it later. Men who have used accumulators ever since their introduction, when they were much less efficient machines than now, continue to use them, and would under no circumstances be induced to part with them. Unmitigated praise on the one hand and unmitigated contempt on the other. Broadly stated, the European concensus of opinion, both technical and commercial, may be said to be in favor of storage batteries. The American view until now has been mainly the opposite. What is the ground for this wide discrepancy? Why is cautious, conservative Europe so far ahead in the race? Why is America a laggard in the running?

The answer is not far to seek. Storage batteries are almost always an economical success abroad, while here they have been too often an economical failure in the past. And the reason is that the European always demands a margin for safety, while the American, with less capital and keener competition, is tempted to sail too close to the wind.

A storage battery continually worked to its commercial rating is a commercial failure. A storage battery worked sufficiently within its capacity is invariably a commercial success.

It has been said of Watt that he pursued careful and exhaustive experiments upon the power of horses for all day work, and that he ascertained that the average power which they could maintain for ten hours was 22,000 foot pounds per minute, but in rating his engine he added 50 per cent. and called the horse power 33,000 foot pounds per minute, so as to make his new pumping devices more than satisfactory substitutes for horses. Would that storage battery people had been equally wise.

The writer has had occasion to watch with the closest scrutiny a considerable number of plants, aggregating perhaps some millions of plates. These batteries were rated, like all reputable makes, well within their capacity in ampere hours measured by charging the battery to about to 2.65 volts, and then discharging it until the potential difference was 1 8 volts per cell. Some batteries have been spoiled by bad management and neglect, and some by false economy or bad engineering at the very start. By eliminating these there remain a very large number which were successful or were failures for no apparent reason. The utmost care was exercised at the factory. The constituent materials were analyzed as soon as purchased. Able engineers watched the processes of manufacture, but while the quality of the battery was improved until no flaw, mechanical, electrical or chemical, seemed to remain, still an occasional failure occurred in actual practice and the cause eluded our search.

Finally, by classifying the failures and successes, the truth dawned upon us. Wherever the battery was exhausted to its full capacity daily, its life did not exceed 500 discharges, but wherever it was worked within two-thirds of its capacity complaints were unknown.

Exhaustive tests were undertaken, and some curious phenomena heretofore unknown to the writer were disclosed, and after some hesitation he concluded that they might be of interest to this society.

It is natural to ask why the rating should not be changed so that the owner of the battery would not be tempted to work it to the danger limit. That is a commercial question. In these days of close commercial figuring it would be difficult to sell a battery which appeared *cæt ris paribus*, to cost 50 per cent. more than its competitors. The present rating is strictly accurate and has the sanction of custom the world over. It is only necessary for the engineer to remember to add 50 per cent. of the capacity as a factor of safety to his maximum load, just as he allows several hundred per cent. in calculating the strength of a bridge or axle.

This additional amount is not a dead loss in investment. It produces many countervailing advantages. It saves the necessity for regulation in most instances. It provides a very effective and safe reserve for cases where the charging apparatus breaks down and for many other cases, and it improves the actual effieiency of the battery, which arises from about 80 per cent. to nearly 90 per cent. when used with a sufficient reserve. And for cases where it is necessary to maintain a constant difference of potential, such as electric lighting, it raises the efficiency much more, because in these cases the commercial efficiency must be rated not from the average point of electromotive force but from the lowest point to which the battery falls on discharge, and when used in this way the potential difference drops only 2½ per cent. All the electromotive force above the lowest point must be wasted in order to secure regulation, unless the troublesome method of regulating by the introduction of extra cells is adopted.

In circuits where this regulation is of no consequence as in motor circuits for cars, all the electromotive force is utilized in increasing the car miles per unit of energy.

In this connection it is perhaps worth while to call the attention to a very common misapprehension on the part of engineers. A storage battery for trolley systems or other central stations for the production and utilization of electricity has heretofore been regarded in this country as a very expensive addition to the plant. But this is not always the case. There are many opportunities for introducing storage batteries as a part of the original plant without increasing the cost, as for example in cases where the maximum output is two or three times greater than the average output. In the tables here given I have taken Emery's figures for a basis for the steam plant.

1,000 HORSE POWER, DIRECT SYSTEM.

Cost of steam plant	$70,000.00
Electric plant, 750 kilowatts, at $30 per kilowatt	22,500.00
	$92,500.00

1,000 HORSE POWER, STORAGE SYSTEM

One-half steam plant	$35,000.00
One half electric plant (375 kilowatts)	11,250.00
1,500 kilowatt hours, accumulator capacity, at $30 per kilowatt hour	45,000.00
	$91,250.00

Now that batteries are made in large units and in much more compact shape than formerly, with increased facilities for handling, it is to be hoped that the engineers in this country will begin to give the subject of their introduction more attention, especially as a cell having a capacity of twenty-four kilowatt hours occupies a floor space (exclusive of connections) of less than a square yard.

A battery's discharge should be stopped after its electromotive force has fallen to 2 volts or at furthest to 1.9, unless it be desirable to draw upon its reserve. It should be understood that a full discharge, that is, to 1.8 volts, is working a battery to the danger limit and is unadvisable for the following reasons:

a. Regulation is troublesome.

b. Efficiency is low.

c. Dangerous molecular changes take place, as indicated by changes of internal resistance and changes of electromotive force as well as occasional buckling.

d. Uneven plates discharge into one another after the circuit is interrupted.

e. The life of the battery is diminished.

I desire to acknowledge the aid I have received in the study of these phenomena from my very competent laboratory assistants, as well as the accurate and fatiguing work, both night and day, kindly undertaken by two of them, Hugh Lesley, aided by Norman Mellor, in making the measurements and plotting the curves herewith presented for your consideration.

Chicago Edison Company.

The annual meeting of the stockholders of the Chicago Edison company was held on June 11th. The financial statement for the fifteen months ended March 31, 1894, is as follows:

BUSINESS SUMMARY.

Gross income from electric current and sales.		$2,141 779 72
Operating, repairs and renewals and general expense		1,461,102 93
Net income from all sources		$ 680,676 79

Charges Against Net Income.

Interest on bonds and debentures	$171,934 33	
Dividends paid	219 119 60	
Doubtful accounts charged off	35,362 68	$ 426,416 61
Balance carried to surplus account		254 260 18
		$ 680,676 79

STATEMENT OF ASSETS AND LIABILITIES.

Assets.

Plants, real estate and franchise		$6,035,279 27
Work in progress and material, less collections on account		219,695 86
Accounts and notes receivable.	$238,890 72	
Due from stockholders, May 31 and July 31, 1894	450 276 80	
Cash	254,286 16	$ 943 453 68
		$7,197,828 81

Liabilities.

Capital stock		$4,200,000 00
Bonds and debentures		2,325,300 00
Surplus account		254,260 18
Accounts and notes payable.	$ 393 450 45	
Open accounts	24 818 18	$ 418,268 63
		$7,197,828 81

The old board of directors was re-elected. It is composed of the following named gentlemen: A. F. Seeberger, John B. Drake, Lambert Tree, E L. Brewster, R. C. Clowry, Byron L. Smith, Robert T. Lincoln, J. W. Doane, F. S. Gorton, A. A. Sprague, E. M. Phelps, Edson Keith, Samuel Insull. The officers of the company are: President, Samuel Insull; vice-president, J. W. Doane; secretary and treasurer, F. S. Gorton; general superintendent of operation, C. H. Wilmerding; comptroller, W. M. Anthony; electrical engineer, L. A. Ferguson; superintendent of low tension system, W. L. Church; superintendent of high tension system, R. S. Kelsb.

The financial statement shows a net earning of about 9 per cent. per annum, after paying the interest on the bonds. In view of the dull times and the new work now in progress at the Harrison street station, this is considered a very favorable showing.

Arc Lighting Machinery Litigation.

The suit of the Thomson-Houston Electric company against the Western Electric company for alleged infringement of the former company's patent for automatically regulating the current in arc lighting dynamos, was finished last Saturday in Judge Grosscup's court in Chicago and taken under advisement. No witnesses were examined by Judge Grosscup, all the testimony in the case having been taken in the East. This case is an old and important one, and it is said that the depositions of the large number of witnesses called contained about 50,000 words. The lawyers were limited in their arguments to six hours on each side, and they made use of the full time. No opportunity was therefore had to display by practical operation the electrical machinery which had been provided for the instruction of the court. Much of this apparatus was of an historical nature, a number of original models which have figured in other suits being upon exhibition, as well as a number of important charts and drawings. One model was designed to illustrate the practical working of an arc light plant. It consisted of a small dynamo, a diminutive arc lamp, the carbons of which were much smaller than lead-pencils, with the feeding and regulating devices complete. The motive power was designed to be furnished by hand, a couple of geared wheels being in place provided with a suitable crank. The little plant was complete in every detail and attracted considerable attention from those interested in electrical apparatus.

Judge Taylor of Fort Wayne, widely known as a patent lawyer, and who has been engaged as special counsel by the government in the government suit to annul the Berliner patent, made the opening argument for the complainant. The contention of the complainant, in brief, is that the patent in question, 238,315, is a broad patent which covers all means of regulating the current of dynamo electric machines by the automatic shifting of the brushes through the medium of a responsive device responding to changes in the main or generated current of the machine.

The defendants' position is that the patent in suit is invalid, because it is anticipated by the invention of Hiram S. Maxim on a similar apparatus, and that it is not for a patentable invention, in view of the state of the art, which showed that regulation by manual adjustment of the brushes and regulation by the automatic substitution of resistance and other means in response to changes in the main current were old. The controversy was most intense, however, over an earlier patent of Thomson and Houston, 223,659, which the defendants' counsel claimed showed precisely the same invention as the patent in suit. The argument of the complainant was that there is a distinction between the two inventions, and the argument of the defendants that there is no distinction, and this argument led into the very depths of abstruse theories with regard to the operation of dynamo-electric machines. George P. Barton and Charles A. Brown presented the arguments on behalf of the defendants, and Frederick P. Fish closed the argument on behalf of the complainant. Judge Grosscup's decision is not expected for a number of months, and it is regarded as probable that the case will be carried to the Circuit Court of Appeals in any event.

Incandescent Lamp Litigation.

On June 9th, in the United States Circuit Court at Chicago, the Star Electric Light company, the Empire Electric Light company, the Chicago Incandescent Light company and the Co-operative Electric Light company, all Chicago firms, were made defendants in suits brought by the Edison Electric Light company for infringement of the Edison patent on the carbon filament. In the case of the Co-operative Electric Light company, the company believes that the action will not be pressed. As a matter of fact, the company does not supply any incandescent lamps whatever to its customers, but merely supplies current for lamps, which may or may not be infringing, as far as it is concerned.

The injunction asked by the General Electric company in the United States Circuit Court at Boston, before Judge Colt, to restrain the Boston Incandescent Lamp company from manufacturing incandescent lamps, has been granted. The lamps manufactured by the Boston company do away with the use of leading-in wires, utilizing as conductors two strips of a finely divided film of silver adhering to the sides of a glass tube, by means of printer's ink, which, when the tube is melted and pinched together, oxidizes

and disappears. Iron wires are inserted in either end of the tube before it is pinched together, to which the carbon filament and circuit wires are attached. The arguments in the case were noted in this journal April 28, 1894.

New Autographic Recorder.

The New National Time Recorder company, Milwaukee, Wis., is putting on the market an autographic recorder for electric light and power stations. Fig. 1 represents the device, which is 17 inches square. The clock which

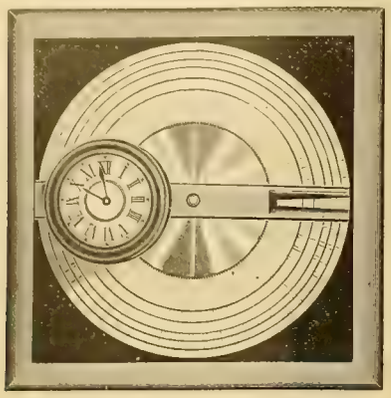


FIG. 1. NEW AUTOGRAPHIC RECORDER.

drives the record-dial is supported in a casting, the ends of which are securely fastened to the wooden frame. The record-dial is secured inside of the frame under lock and key. A small section of the dial is shown in Fig. 2. It is 15 inches in diameter, and when in operation is entirely covered by plate glass with the exception of an opening ½ by 3½ inches on the right hand side, through which the engineer or dynamo tender can write his signature and also the record desired. By referring to Fig. 2 it will be seen that the record-dial is divided by radial lines into 30 minute spaces so that a record may be made every half hour of the amperes, volts, steam pressure, vacuum, dynamos cut out and dynamos started, which records are separated by concentric lines. The heavy black line is the night line and represents the time from 6 P. M. to 6. A. M. Fig. 2 shows as an illustration a record made at 5 P. M. by a day man and a record made at 6:30 P. M. by a night man. On a dial having been used it should show a record every half hour. The dials are made to cover a space of 30 hours, so that in case whoever keeps the records does not always change the dials at a certain hour each day, there will be six hours leeway, so that the records can not be confused. By an ingenious device, in changing the dials each day the dials are always synchronized with the clock.

By the use of this recorder it is absolutely necessary that the employe should make his record regularly at stated intervals, otherwise that portion of the dial where the record should have been made will have passed on under the glass without the record having been made, showing the employe to have been negligent, and that he has not attended to his duty. This recorder can as easily be adapted to many other kinds of business where a half-hourly or hourly record is desired, the only change necessary being in the printing of the dials.

The Fort Wayne Complications.

Receivers were appointed for the Fort Wayne Electric company on June 6th by the Superior Court, at Fort

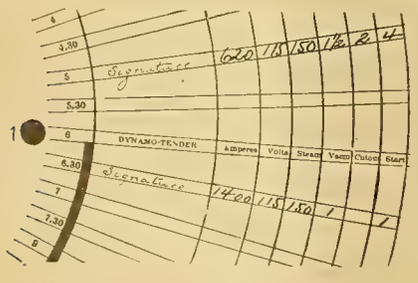


FIG. 2. NEW AUTOGRAPHIC RECORDER.

Wayne, Ind., upon the application of R. T. McDonald. A new concern was immediately organized under the title of the Fort Wayne Electric corporation (capital stock $1,500,000), and a contract was made with the receivers of the old company, Henry J. Miller and Edward J. Hathorne, providing for the new concern conducting the business of the old company. The affairs of the company will be managed by five directors, and for the first year R. T. McDonald, Charles C. Miller, M. C. Gross, Sidney C. Lumbard and Charles S. Knight of Fort Wayne will be the directors. R. T. McDonald is the president of the company. It has been known for some time that there was considerable dissatisfaction over the arrangement between the Fort Wayne company and the General Electric, and last week's proceedings were the outcome of the controversy. On June 8th, according to the press dispatches from New York, the General Electric company obtained an attachment for $500,000 against property of the Fort Wayne Electric company in New York. The attachment is for money advanced between May 1, 1892, and May 1, 1894. The suit has been brought to protect the General Electric company, and an officer was sent to serve the attachment at the Fort Wayne company's office in the Edison building. Mr. Adams, the manager, said that on June 6th the Fort Wayne Electric corporation bought from the receivers the plant, tools and office furniture of the Fort Wayne Electric company. Copies of the attachment have been served on the National Broadway Bank, in which it is said the company has an account, and on several brokers who are supposed to have assets of the company.

The Indianapolis *Journal* publishes the following statement of the condition of affairs, which is believed to represent the Fort Wayne stockholders' views:

The cause of this complication has been the determination by the eastern managers of the General Electric company to move the works from this city to an eastern city. R. T. McDonald opposed and threatened to withdraw from the company. Then came the fire that destroyed the works and an order to reinstate the local plant in Brooklyn. Mr. McDonald refused and laid the matter before Fort Wayne citizens, and $25,000 has been raised to rebuild the works. The company was compelled to accept the donation and to continue the industry at this point. Last year the general business depression caused a great falling off in business everywhere, and the Boston concern and other

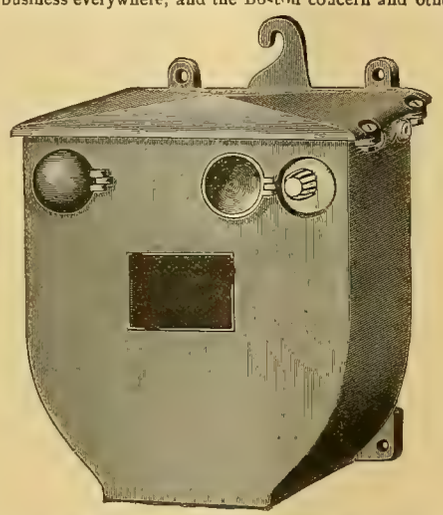


FIG. 1. NEW CONVERTER CUT-OUT.

branches were shut down. Mr. McDonald received orders to temporarily close the Fort Wayne factory. He refused, and showed that the works here were full of work, and he wouldn't make harder the lot of workmen whose hours had been reduced. The relations between McDonald and the managers of the General Electric company, which held a large portion of the stock in the local company, became strained, and the annual election was approaching, and the imminent danger of the loss of the works forever threatened Fort Wayne, and upon application of McDonald, E. J. Hathorne and Henry J. Miller were appointed receivers of the old company. There is money to liquidate every dollar's worth of indebtedness, and every debt will be met and paid promptly. The new company will absorb all current contracts and business of the old company, together with that of the Fort Wayne-Jenney Electric company.

Municipal Electric Lighting Plant for Toronto.

City Engineer Keating is in favor of the city of Toronto investing in an electric street lighting plant, and he says that in his opinion about $30 can be saved per lamp per year on the present cost, $108 58, by the city owning and operating its own plant. During 1893 the city paid $135,243.17 for street and park lighting, of which sum $105,293.56 was for electric lights and the balance for gas lamps. There are now in Toronto about 1,000 arc lights and 1,100 gas lamps distributed throughout the city for street lighting purposes. The capacity of the proposed station will be sufficient to run about 1,500 lights. Mr. Keating has been in communication with the Cataract Construction company of New York regarding the transmission of power from Niagara Falls, but no definite offer has yet been made by the company. There appears to be a difference of opinion in Toronto as to the feasibility of conveying power from this source such a distance to compete with steam. The Cataract Construction company, however, proposes transmitting power to Buffalo before the end of this year, and when this is done the public will be better able to judge as to the commercial value of the undertaking. The Cataract company has notified Mr. Keating that it will not be in a position to transmit power to Toronto before September, 1895.

New Converter Cut-out.

The Packard Electric company have recently designed and placed upon the market, in connection with Packard transformer, a new transformer cut-out which of interest to those interested in alternating current work. The difficulty in securing a desirable transformer cut-out has been to make it perfectly safe and convenient to handle and at the same time to secure an absolute and sufficient

FIG. 2. NEW CONVERTER CUT-OUT.

electrical contact and a suitable system of fusing the removable part of the cut-out.

The transformer itself has been fully described in these columns. The illustration of the transformer in Fig. 1 shows the manner in which the fuse plugs project from the front of the case so that they can be easily withdrawn or replaced. Protection is afforded by a hinged cap which entirely covers and conceals the porcelain handle. Thus the transformer can be cut out of circuit and a burned out fuse replaced without the use of any tool whatever. The plugs are made interchangeable, so that a new plug can be slipped into the place of the old one and the old plug can be re-fused for use again at any time. As shown in Fig. 2, the fuse lies along almost the entire length of the plug on one side, which has been recessed to allow a groove for the fuse strip, where it will be safe from mechanical injury in withdrawing or replacing. The plug is provided with two metal lugs, between which the fuse is connected. One of the lugs covers the entire end of the plug, the other extends entirely through the plug making a double contact with its corresponding metal surface within the cut-out block.

The cut-out block, Fig. 3, is a sufficiently heavy piece of porcelain to insure it against breakage in case the transformer should suffer from rough handling. Divided by a thick porcelain wall two compartments are seen at either end of the block. In these is made the contact with the two ends of the plug. To insert the plug it is held with the projecting lugs in a perpendicular position so that they will pass through the slots shown in the first contact plate within the block. As the end of the plug comes in contact with the rod carrying the spiral spring in the second compartment, a slight pressure is necessary. This forces the spiral spring back, making a perfect contact with the metal rod at that end and allowing the double lug of the plug to pass through the two slots in the first contact plate mentioned. A quarter turn to either the right or left throws the double lugs firmly against the first contact plate, where they are held by the pressure of the spiral spring at the other end of the plug. In this way a perfect contact is assured at both ends of the plug. The fuse box and plug are both made of the best porcelain, vitrified and highly glazed, and are made sufficiently strong to prevent breakage under ordinary conditions. The Packard Electric company and the Electric Appliance company, Chicago, the general western agent, are confident that the new plug will add greatly to the popularity

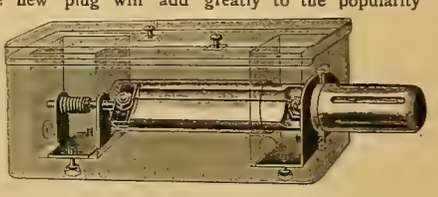


FIG. 3. NEW CONVERTER CUT-OUT.

the Packard transformer, which has already established a reputation for service.

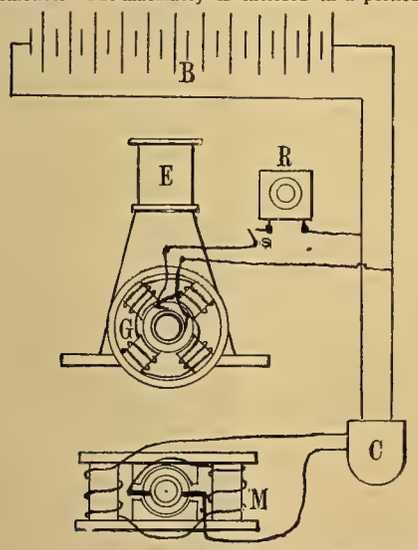
New York Electric Club.

A number of the members of the New York Electric club, cherishing the remembrance of the days when the society was in existence and was an important factor in electrical circles in New York, have sent a circular letter to the remainder of the members suggesting the idea of holding an annual dinner, in memory of the club, and as a partial realization of its excellent aims and objects. This year it is proposed to hold the dinner at the Imperial Hotel and it is believed that it will do all interested good to get together, to sympathize with each other in the hard times

and to exchange hopes as to the better days coming. Those who intend to participate in the dinner on June 21st should express their intention, accompanied by a check for $5, to George F. Porter, 136 Liberty street, New York. The letter is signed by C. O. Baker, Jr., Charles D. Shain, P. H. Alexander, Charles W. Price, R. B. Corey, John A. Seely, George M. Phelps, T. C. Martin, J. W. Godfrey, E. F. Peck, Stephen L. Coles, George T. Manson, W. L. Candee, Clarence E. Stump, George F. Porter and E. E. Bartlett.

Patton System of Street Car Propulsion.

The Patton street car motor that is now in operation on the Calumet Electric Railway company's line at Sixty-seventh street, Chicago, presents one solution of the rapid transit problem, for it is equally well suited to the crowded city streets and the long lines through sparsely settled districts, as the smaller cost of installation and the economy of operation, together with its independence of a base of supplies, or a central power station, fit it for all kinds of rapid transit lines. This plan is the result of several years' work and study to discover and perfect a system for intramural traffic which would supersede the trolley and be devoid of some of its objectionable features. The system, as now perfected, consists of the combination of a gas engine, electric generator, storage battery and an electric railway motor, arranged in the most compact and convenient manner, making a simple, reliable, and economical locomotive. The machinery is inclosed in a portion of



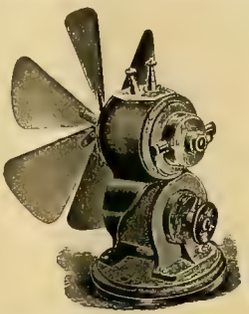
PATTON SYSTEM OF STREET CAR PROPULSION.

the car, and after being once started requires no particular attention during the day's run, as the engine is entirely automatic and the storage battery serves to control the generator when the motor is not taking current.

The gas engine is of the vertical type, and is located in the center of the car and supported directly by the truck, the floor of the car being cut away for this purpose. The electric generator is connected to the engine direct, so that the two machines take up but little space, and there is no loss in transmission by belting or other gearing. The generator is of a well known type and shunt wound. The storage battery consists of cells of the Planté type, and the number will be regulated by the requirements of the road on which the motor is to be run. In the present instance there are 110 cells. The motor, of the ordinary railway type, is placed on the truck in a manner similar to that employed in all electric cars and is controlled by a standard controller.

The arrangement of the machines and the electrical connections may be understood from the accompanying illustration, in which the gas engine is shown at *E*, the generator at *G*, the battery at *B*, and the motor at *M*. The controller is shown at *C*. At *R* is a rheostat or starting box connected between the generator and battery, and a switch *S* in this circuit completes the arrangement. A shunt wound generator, when used to charge a storage battery, will act as a motor and revolve in the same direction, without any change in the connections, if current from the battery is passed through the generator. This principle is utilized for starting the engine. The generator has a voltage of 250, and the storage battery is of 220 volts, from which it will be seen that as soon as the generator is up to speed, current is made to pass through the battery, where the energy is stored, but if the motor be started it will take current from the generator only, the surplus of current going to the cells, so that the battery remains fully charged, or nearly so, at all times. All the actions described take place while the engine is running, and without any change in any of the switches or resistances, except the usual manipulation of the controller, and there is no loss of power, as the surplus energy is stored in the battery for use when required.

The power of the engine need not be nearly so great as that required by the heavy grades on the line, for the storage battery may be utilized to furnish the extra power required. So soon as the demand on the generator is beyond its capacity, the engine slows down and the voltage of the generator is reduced. As soon as this occurs, current from the battery also flows to the motor, and this addition of current from the reserve enables the car to easily overcome the increased resistance, and it mounts the grade with but little decrease in the speed. From the above description it will be seen that neither engine nor motor is required to be as heavy as the grades of the road would require if the cars were operated on any of the other systems now employed. This motor has been in daily operation on this line for some time. On this line there is an eight per cent. grade, which the car, pulling a standard sized trailer, mounts with ease, even when started from the foot of the grade, which shows a large surplus power. Its regular rate of speed is 15 miles per hour, but it can be geared to run at any speed desired. When in operation the motion of the car is as smooth as that of any vehicle, and there is no disagreeable noise from the working of the machinery. The motor car seats comfortably thirty-six persons, although it is but 16 feet in length. The power required, when pulling a trailer, is not great, as the engine consumes but 20 gallons of gasoline during a 12 hour run. The dynamo has a capacity of 65 amperes, and that of the battery permits a current of 40 amperes to be taken from this source. It is the intention to build these cars as locomotives designed to haul as many trailers as may be required, this being the best plan where the traffic will warrant or where there is any objection to combination cars. The motor car, which weighs about 15,000 pounds, is the invention of W. H. Patton of Chicago, who has patented it in the United States and Europe. It is being introduced by the Independent Electric Traction company, Chicago.



NEW MUNCIE FAN MOTOR.

New Offices of the Allen-Hussey Company.

Among the changes which some of the electrical houses of Chicago have found it necessary to make, owing to the increasing volume of business, may be mentioned the removal of the Allen-Hussey company, general electrical

NEW OFFICES OF THE ALLEN-HUSSEY COMPANY.

contractor. The business of the company having increased to a large extent, it was found necessary to seek larger and more roomy quarters at 818 Medinah building. A view of a portion of the offices is shown in the accompanying illustration. The Allen-Hussey company has been in business for a number of years, at one time operating under the name of Hussey & Co. A. R. Hussey, the head of the firm, has had an experience of more than 15 years in almost every branch of electricity, and is well known in Chicago. The principal business of the company is electrical construction work, although it is prepared to do anything in the electrical line. The company makes a specialty of difficult and complicated work, and has in hand at the present time about 60 different contracts. Among the most important installations made by this firm of late may be mentioned the combination speaking tube, annunciator and electric call bell system in the Y. M. C. A. building, Chicago, which is one of the most modern of its kind in the city. It is just completing a contract for wiring 1,500 lamps in the stations of the Metropolitan West Side Elevated Railroad company, Chicago, which are distributed over a distance of about eight miles. The new office of the company, which is handsomely fitted up, is about double the size of the former one. A large store room in the basement of the Medinah building is also occupied by the company, in which is kept a complete supply of almost every article used in construction work. The prospects of the company are excellent, and with the increased facilities at its command it is prepared to do reliable work even more expeditiously than heretofore.

Ceiling Fan Outfit.

The Chicago Water Motor & Fan company, Chicago, has placed upon the market the electric ceiling fan equipment, shown in the accompanying illustration. In this arrangement the motor and fan are combined, a powerful motor and a particularly long blade being used. The Globe pattern is shown in the illustration, but a variety of styles

CEILING FAN OUTFIT.

is manufactured by the company, ranging from the ordinary japanned basket style to the highly finished, handsomely nickeled type. The company also makes a specialty of furnishing a line of fans, belt driven, as in many instances it is found desirable to use a more powerful motor than is necessary to drive the fan and to utilize the surplus power for other applications.

New Muncie Fan Motor.

The Muncie Electrical Manufacturing company takes pleasure in presenting to the trade for the coming season its new type of fan motor, which has many novel features. It is extremely light and weighs only 17 pounds, complete, being remarkably small for its speed and output. The bearings are made of aluminum, and present a bright and pleasing appearance. The machine is provided with a controller, which gives three different speeds at will.

The commutator, brush holders and armature are built in an improved manner, and are completely protected from dust or dirt by the bearings. The shaft revolves in lignum vitae bearings, which permits of perfect lubrication and noiseless running. Each machine is furnished with a desk base or wall bracket, as desired, and the fans are protected with a guard. The machines are built of the best material, and with proper care will last a long time. By improved labor saving machinery and tools the firm is able to place them on the market at a low figure.

Electrical Equipment for the Metropolitan Elevated Railway, Chicago.

Bids are being received for the boilers, engines, generators and motors for the electrical power service of the Metropolitan "L" road of Chicago. The bidders for the generators are the General Electric company, the Westinghouse Electric & Manufacturing company, the Siemens & Halske Electric company of America and the Walker Manufacturing company. It is also stated that the Electric Construction company (Elwell & Parker) of London was invited to put in a bid, but as the duty on dynamo-electric machines under the present tariff schedule is 45 per cent. *ad valorem*, it is not probable that this company can compete with the American manufacturers. The specifications call for 2,000 and 1,000 horse power machines, which will probably be directly coupled to the engines. The larger generators will be operated at 75 revolutions per minute and the smaller ones at 100 revo-

lutions. The ultimate capacity of the power house will be about 8,000 horse power, but as every effort is being made to have the road in operation by September 1st, the bidders are asked to make estimates on 6,000 horse power —two 2,000 horse power machines and two of 1,000 horse power each—as well. One hundred and ten motors of 125 horse power each will be required at first to equip 55 motor cars. It is likely that each motor car will ultimately be equipped with 500 horse power in motors, but at the start two 125 horse power motors will be used for each car. The bids will be opened in a few days, and the successful competitor will be required to build the machinery with all possible speed.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 11.—It has been well known for some time, in fact ever since the $50,000 offer was made for a new discovery of a new and suitable system of rapid transit, that the Metropolitan Traction company had considered the project of building a conduit electric system. It is now definitely announced that a contract has been awarded to the General Electric company for the equipment of three miles of conduit electric railway in the upper part of New York. If the experiment prove a success, the system will be considerably enlarged, and will, it is stated, replace some overhead trolley lines. The system, which will be built by the General Electric company, is similar to that of the Siemens & Halske system, for which negotiations were made by the Metropolitan company at one time. A current of only 300 volts will be developed.

Last Friday marked the first meeting and organization of the new rapid transit commission. No action was taken beyond an election of members and officers and a motion to provide by-laws and a meeting place for the commission. It was generally conceded that Charles S. Smith would be elected as a member, for as the last president of the Chamber of Commerce he was practically named as a member. His term, however, expired before the commission became a reality and he was succeeded by Alexander E. Orr, who was mentioned in the rapid transit bill by name. Thus a vacancy was created, which it was reasonable to suppose Mr. Smith would be called upon to fill. The action of the commission, therefore, in electing John H. Inman, a member of the former commission, came somewhat in the nature of a surprise. The commission now consists of the following members: Mayor Gilroy, Comptroller Fitch, Alexander E. Orr, Seth Low, John Claflin, William Steinway, John H. Inman and John H. Starin. Mr. Orr was elected president of the commission and it was decided to hold the first regular meeting next Monday.

Mayor Schieren's veto of the resolution granting a franchise to the New York & Eastern Telephone & Telegraph company was overridden last week by a vote of 13 to six. The meeting was a stormy one and many hints of fraud were made. Speaking of the franchise, the mayor is reported as saying: "It was altogether too broad in scope and gave the company altogether too much power. It placed no restrictions upon it whatever, and allowed it to tear open the streets, lay wires and pneumatic tubes, and do whatever it pleased, and I thought that was all wrong."

At a meeting of the Board of Electrical Control in the mayor's office last Thursday the statement was made that several of the gas companies in the city had violated their obligations to the municipal authorities by laying in the excavations for their mains pipes containing electrical conductors. This was in direct violation of their contracts with the subway commissioners. The discovery was not made until a few days ago. The mayor offered a resolution directing Commissioner of Public Works Daly to make an investigation and have the conductors taken out wherever they were found. The mayor explained that the gas companies laid their pipes at night. Mayor Gilroy called the attention of the board to the delay of the Thomson-Houston company in putting its wires in the subway in Fourteenth street, between Eighth avenue and the North river. Henry Winthrop Gray is receiver of the company, and he has notified the board that if the poles of the company are cut down it will be held for contempt of court. The matter was settled by a representative of Mr. Gray promising to obtain the consent of the Supreme Court to give a bond to the subway company for the payment of rent while the company is in the receiver's hands.

The electric light, of which mention has been already made, recently erected at Sandy Hook, N. J., was operated June 4th for the first time in the East. The light was exhibited at the World's Fair. So intense and far-reaching were the rays that places far down the Jersey coast, on Staten Island and Coney Island were plainly visible. Vessels at anchor in the bay appeared almost as plainly as in daytime. The weather was not suitable for the perfect working of the light, but even with this condition against it the rays must have been visible for a great distance. It is claimed that the light can be thrown without difficulty as far as Philadelphia.

W. C. Humstone, superintendent of the Western Union Telegraph company, said Saturday that he did not credit the report that the telegraph operators had organized a union and were arranging for a general strike to compel the telegraph companies to increase their wages. The statement was made by an operator, however, that a secret organization of operators had been formed and that a strike was inevitable. The men are dissatisfied with the present arrangement under which they are working, because it gives them employment on only four or five days a week. W. F. O.

PERSONAL.

W. H. Moore has been appointed electrical inspector of La Grange, Ill.

Prof. R. B. Owens, of the University of Nebraska, was in Chicago on Monday.

C. C. Smith, the street railway engineer of Milwaukee, was in Chicago last week.

E. B. Duncan, of the El Paso, Tex., Electric Works, paid Chicago a visit last week.

Cyrus W. Field, Jr., a son of the late Cyrus W. Field of Atlantic cable fame, died in New York on June 9th.

A. Mitchell Hall of New York, general manager of the C. & C. Electric company, was in Chicago last week.

F. Uppenborn, editor of the *Elektrotechnische Zeitschrift*, has accepted the appointment as city electrician of Munich, Germany.

R. C. Brown, who has been connected with the West End Street Railway company, Boston, as electrical engineer for five years, has resigned his position to accept a similar one with the Montreal Electric Railway company, Montreal, Que.

Elihu Thomson was in Chicago last week in attendance at the hearing of the case of the General Electric company against the Western Electric company regarding the alleged infringement of the automatic regulating devices for arc dynamos owned by the General Electric company.

Elbert F. Norton has severed his connection with the Chicago electrical inspection department, and is now engaged upon expert work. Mr. Norton was chief inspector of the department for a time, and while in that capacity raised the standard of inspection considerably and made many friends.

J. W. Johnson, manager of the lighting department of the western office of the General Electric company, Chicago, has severed his connection with that company. Mr. Johnson's resignation will doubtless be something in the nature of a surprise to his many friends, as he was one of the company's most experienced and valuable men. Besides attending to personal business Mr. Johnson will avail himself of the opportunity for a much needed rest.

NEW INCORPORATIONS.

Chicago Suburban Electric company, Chicago, Ill.; capital stock, $1,000,000; to construct and operate street railways.

Economic Electric Engine company, Chicago, Ill.; capital stock, $100,000; to manufacture and sell electric motors, engines, etc.; Charles A. Jackson, Chicago, Ill.

Akron & Cuyahoga Falls Rapid Transit company, Akron, O.; capital stock, $300,000; to build an electric street railway from Ravenna, O., through Kent and Akron to the village of Barbeton.

Council Bluffs & Lake Manawa Electric Railway company, Council Bluffs, Ia.; capital stock, $50,000; to build and operate an electric railway from Council Bluffs to Manawa, Ia.; J. W. Bedford, Council Bluffs, Ia.

TRADE NEWS.

The E. P. Gleason Manufacturing company has removed its Chicago office to 183 Dearborn street, where the resident representative, F. L. Johnson, will have improved facilities to look after the company's Chicago business.

The New Era Iron Works have been incorporated at Dayton, O., with a capital stock of $50,000 to manufacture gas engines and iron specialties. Their engine, the New Era, has been in successful operation for nearly two years. It will be built principally in the larger sizes, and especial attention given to its construction for private electric light plants.

The American District Steam company, Lockport, N.Y., is calling attention to its Holley system of underground steam distribution for heating dwellings, stores, offices, churches and public buildings by exhaust steam from steam-driven electrical plants and other steam machinery. The system has been designed to add to the economy of operation of such plants.

The demand for the Allen soldering stick, a specialty of the Electric Appliance company, Chicago, as a substitute for soldering salts and acids, keeps briskly on, and is increasing from day to day. The company has received among numerous testimonials on this specialty a letter from one enthusiastic customer who says that with the Allen soldering stick he can solder everything; that he is even able to solder common iron spikes solidly together without filing the surfaces in any way.

A valuable book to those interested in this country's commercial relations with Mexico has been issued by Philip G. Roeder, Cleveland. The volume is called an exporters' hand book of Mexico and enumerates the leading manufacturers and business men in that country, as well as dwelling upon the custom house regulations. Mr. Roeder reports a growing demand for American electrical machinery, and a perusal of his work will doubtless be of interest to the electrical trade.

The Stanley Electric Manufacturing company, which has just placed upon the market its new two-phase alternating current system of electrical distribution, is building an extensive addition to its factory at Pittsfield, Mass. The company has also opened a western office at 307 Dearborn street, Chicago, in charge of J. B. Wallace and William S. Hine. Both of these gentlemen are experienced electrical men, and they regard the prospects of the new apparatus as exceedingly bright.

The Lynn Manufacturing company, Boston, Mass., is calling the attention of the trade to its electric railway line material which is now in use on many of the leading roads in the country. Each piece is made of bronze and gun metal castings, thoroughly tested before leaving the factory, and insulated with the sinew compound, which is noted for high insulation, toughness and durability. It is the aim of the company to produce goods which will recommend themselves. An illustrated catalogue has been recently issued by the company.

The Simplex Electrical company has opened a Chicago office for the sale of its insulated wires at 1137 and 1138 Monadnock building. The western business will be in charge of H. R. Hixson, who was for several years with George Cutter, the former western selling agent, and who has a wide acquaintance with the local trade. Mr. Hixson is energetic and popular, and can hardly fail to score a success in his new position. A stock of Simplex wire will be kept on hand in the basement of the building at 308 310 Dearborn street, and from it prompt shipments can be made.

The Commercial Electric company, Indianapolis, Ind., has issued an illustrated folder which, in addition to describing its type of dynamos and motors, contains a number of testimonials regarding their operation. The special advantages of these machines are wrought iron fields, single depth of wire on the armature, low armature resistance, short air gap, small exciting force required in fields, small floor space required, light weight, moderate speed and high efficiency. The company carries a large number of these machines in stock and thus is enabled to fill orders promptly.

The Metropolitan Electric company, Chicago, has upon exhibition in its store, 186 and 188 Fifth avenue, a full line of the Kester arc lamps in all styles of ornamental fixtures and globes. These lamps are being extensively pushed in the West and possess many qualities of merit which will be taken into consideration by purchasers of arc lighting apparatus. The company has been having a large sale of the P. & B. products, and I. X. L. weatherproof wire has also been attracting considerable attention. The sales of Mac tape have been very satisfactory and N. I. R. wire has been as successful as usual.

A copy of the new catalogue issued by the Electric Storage Battery company of Philadelphia has been received from Pierce & Richardson, No. 1409–1410 Manhattan building, Chicago. This catalogue is one of the most complete ever issued by an American company in the accumulator business and contains, first, a list of the allied companies for the manufacture of the chloride accumulator, then a brief description of the process of manufacture, curves showing capacity at various rates of discharge, and efficiency curves, a comparative table of the various makes of batteries, and the specific guarantees as to maintenance which this company makes. A picture of the central station at Germantown, Philadelphia, Pa., is given, and the work of the chloride accumulator on street cars in Paris is described at some length. It is a matter of interest to know that in this system alone there are 61,700 plates and the batteries have now run over one million car miles. The remainder of the catalogue is occupied by tables describing the different sizes of plates and elements manufactured by the company, together with instructions for setting up and using the elements. Two flattering testimonials close this extensive catalogue, which will be placed in the hands of all interested in accumulator work.

BUSINESS.

The battery fan motor sold by the Wallace Electric company, Chicago, is meeting with considerable success. It is equipped with an eight-inch fan and runs on a fifteen ampere hour storage battery cell for about thirty hours. The motor is well constructed and is an excellent article.

The argument on the motion of the Consolidated Electric Storage company against the Electric Storage Battery company, manufacturer of the chloride battery, for a preliminary injunction was brought to a close June 7th before Judge Green in the United States Circuit Court at Trenton, N. J.

The C. & C. Electric company is pushing the sale of its type M motor, which is noted for its high efficiency, mechanical construction and regulation. It has self-aligning and self-oiling bearings, automatic cut-off, double-pole starting boxes and reaction brush holders eliminating wear on the commutator.

S. S. Creider, Sterling, Ill., manufacturer and dealer in electrical and surgical instruments and appliances, is the agent for the Viaduct magneto fire alarm system. He

makes a specialty of electrical engineering, makes estimates for isolated plants, installations for light and power purposes and does storage and primary battery work.

The Metropolitan Electric company, Chicago, has become the general western agent for the Kester compound for commutators, which, although very well introduced in the East, has not become so well known in the western territory. It is manufactured by the F. P. Little Electrical Construction & Supply company of Buffalo, N. Y.

The D'Unger Long Distance Telephone company, Chicago, announces that it will install the following exchanges this summer: In Minnesota, 41; New York, 11; Florida, 3; Alabama, 6; Wisconsin, 5; Illinois, 11; Indiana, 4; Ohio, 16; Kansas, 9; Missouri, 13; Arkansas, 3; Michigan, 19; New Jersey, 2; Massachusetts, 11; Tennessee, 2. The number of instruments to be installed ranges from 18 to 600.

W. S. Seaman & Co., 216 East Water street, Milwaukee, Wis., are placing upon the market a line of telephone booths embracing a variety of more than 20 patterns These booths are sound-proof and neutralize the noise of pavements, typewriting, telegraph instruments and all kinds of machinery. A catalogue has been issued by the firm which gives full particulars and which will be sent upon application.

F. A Scheffler, who has been connected with the Stirling company for the last year as its sales agent in New York, has gone to Boston, where he will co-operate with J. Bradford Sargent, the New England representative of the Stirling company, in his efforts to bring the Stirling boiler more prominently before the steam users of that section. John MacCormack, who is well and favoarbly known to the boiler trade throughout the East, succeeds Mr. Scheffler as manager of the New York office of the Stirling company.

The Electric Appliance company, Chicago, is calling attention to the fact that the pleasing effects in fancy illumination which form such an attractive feature of the Masonic Temple roof garden and scenic theaters are produced entirely by Packard lamps furnished by the Electric Appliance company. Several thousand Packards of all sizes, shapes and colors are used in producing the beautiful effects.

The Great Western Manufacturing company, Chicago, which recently removed from 207 South Clinton street to more commodious quarters at 116–120 Market street, reports that the prospects for doing a good business within the next few months are very encouraging. The company's facilities for filling orders promptly are better than ever before, and with the large number of excellent specialties, together with its popular type of electrical machines, enable the company to meet any demand made on it.

W. B. Stewart is now a partner in the firm of E. P. Roberts & Co., mechanical and electrical engineers, Brainard block, Cleveland, O. Mr. Stewart has had 29 years' practical experience in steam engineering and general machinery and eight years in electric light and electric railroad work. He is a fine machinist and undoubtedly the firm will be very much strengthened by his connection with it. The consulting business of the firm is at the present time in a flourishing condition; it has 10 engines and dynamos being placed under its specifications and awaiting its tests, as well as several boilers, and also some miscellaneous machinery. The preliminary estimates for a 30 mile electric road and a number of wiring plans, of which the firm makes a specialty, the mechanical and electrical design for a 15 ton elevator with special machinery, and two legal cases for which E. P. Roberts & Co. are technical experts have been secured.

Announcement is made that the Co-operative Electric Light company, Chicago, has purchased from the Westinghouse Electric & Manufacturing company a directly connected outfit consisting of an alternator of 3 500 lights capacity driven by a Westinghouse engine of 330 horse power capacity. The addition of this machine at the company's North Side station will give it a capacity of about 13 500 lights. The business of the company is being extended and it is not improbable that a second station may be added some time in the future. The existing station was illustrated and described in the WESTERN ELECTRICIAN of March 3, 1894. Among the electrical machines is the large directly connected Siemens & Halske alternator exhibited at the Frankfort Exposition.

McLeod, Ward & Co., 91 Liberty street, New York, are pushing the sale of their specialties with considerable success. The Kinsman desk light in particular is being extensively introduced, both in its stationary and portable forms and several new styles and applications of the lamp have been recently made. The safety insulator, which was only recently placed upon the market, has rapidly become popular and is now one of the firm's leading specialties. It presents a neat appearance mechanically and electrically and does not injure the insulation of the wire. There is a slight rise on the upper piece of porcelain, so that when the lower piece is screwed up the wire is clamped firmly, and is thereby bent slightly, so that it cannot be pulled in either direction. It can be put up very readily without the use of a screw-driver or other tool.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued June 5, 1894

520,763. Multiphase Current Motor. Louis Bell, Boston, Mass.

The invention consists of the combination in an electric motor of a member having a multiphase winding, a second member in intimate magnetic relation to the first, the second member having a winding by which direct currents are passed around the poles and substantially surrounding the first member, and so disposed as to produce a practically continuous line of poles around the member upon which it is situated, and a closed circuited winding also disposed in the pole faces so as to produce a continuous polarity substantially surrounding the face member.

520,764. Method of and Means for Starting Alternating Current Motors. Louis Bell, Boston, Mass.

The invention relates to methods for starting single-phase alternating current electric motors, and has for its object to so arrange the starting mechanism that such motor shall have considerable torque at starting or be capable of starting under load, it being especially adapted to the case of alternating current induction motors comprising an inducing element such as a field magnet coil, or coils, conveying the alternating current, and an induced element such as an armature wound with closed circuited conductors.

520,772. Fuse Box. Axel Eckström, Lynn, Mass.

The invention relates to safety cut-outs or fuse boxes for electric lines, and its object is to protect the fuses from the weather, permit them to be readily inspected and facilitate their renewal when burned out.

520,773. Armature for Dynamo-electric Machines. Hermann F. T. Erben, Schenectady, N. Y.

The invention relates to armatures for dynamo-electric machines, and particularly to those designed for the generation of large currents in direct driven multipolar generators, and has for its object to provide efficient ventilation, a strong mechanical construction, a means of leading the large conductors used in such armatures around the spider arms without the complication which has been found necessary to preserve the strength of the spider, and efficient means of clamping laminations of the core.

520,776. Lightning Arrester. John W. Gibboney, Lynn, Mass.

The invention consists in a constantly maintained short circuit of sufficiently high resistance to prevent any leakage of the working current or permitting free passage to static charges. A spark gap arrester is used to carry off the heavy static charges.

520,780. Electric Motor Truck. John C. Henry, Westfield, N. J.

The invention has in view the combining and arranging of the parts in such a manner that the truck frame, side rods and track rails all assist in forming a path for the conduction of the magnetic lines of force from one pole piece to the opposite one; the placing of the speed reducing gears in such a position that they are protected from injury by the car wheels and track rails, and a means of regulating the motor without artificial resistance, dangers from self-induction or injuries from flashing, as well as means for protecting and insulating the field coils in a liquid insulation.

520,781. Dynamo-electric Machine. Albert B. Herrick, Schenectady, N. Y.

This invention is a method of and apparatus for taking a plurality of currents of different potential from a single dynamo-electric machine, and has for its object to provide an efficient means of compensating for the drop in an extended system of distribution.

520,782. Electric Motor. Alfred Hinman, Olympia, Wash.

Claim 1 reads:

In an electrical motor the combination with a supporting frame, of two or more field magnets within the frame, the projecting ends of each of the field magnets being beveled and pointed; a supporting shaft mounted within the standards, and provided with two supporting disks, these disks having radial seatings adapted to removably hold a series of armature coils, one of the disks being dished so as to provide a supporting sleeve; and a commutator fixed to the sleeve, as well as the usual accesories of the electric motor.

520,784. Electric Motor Controller. William J. Hopkins and Theodore Stebbins, Boston, Mass.

The invention relates to electric motor controllers, and is designed particularly for use on electric railway cars where two or more motors are employed, and where variations in speed are obtained by changing the relation of the motors from series to multiple, or vice versa.

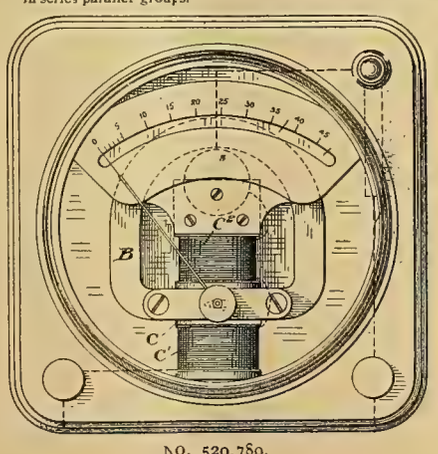
In claim 1 the inventor states a method of controlling electric motors, which consists in first connecting them in series with a resistance, gradually cutting out the resistance, connecting the motors in multiple, and simultaneously reinserting the resistance in series therewith, and finally gradually cutting out the resistance.

520,786. Ear Pad for Telephone Receivers. James W. Kinniburgh, Wellington, New Zealand.

The inventor describes an ear piece for telephone receivers. The invention consists in providing an ear piece which can be adapted to the outside of the orifice of ordinary telephone receivers by suitable clips or attachments, the object being to produce a device which may be placed upon the surface exposed to the ear and readily renewed when desired.

520,787. Electric Locomotive. Walter H. Knight, Lynn, Mass.

The invention relates to electric locomotives in which there are two or more axles, each provided with a driving motor, and in which the several motors are provided with a controller, which is in effect a switch for connecting the motors either in series or in parallel, and also preferably at intermediate points in series parallel groups.



NO. 520,789.

520,788. Stand for Controlling Electric Circuits. Edward R. Knowles, Middletown, Conn., and Edwin H. Park, Millbury, Mass.

The invention relates to apparatus for controlling currents of electricity supplying power to electric translating devices, such as motors and lamps. While it is useful in controlling, either at a distance or near by, one or more translating devices of any kind, it has been more particularly designed to govern an electric searchlight or projector.

520,789. Voltmeter. Edward R. Knowles, Middletown, Conn.

The lines of force of the permanent magnet *B*, in the accompanying illustration, thread themselves through the soft iron needle or armature *H*, and turn it until it comes to rest in the position shown in the dotted lines in the drawing. The torque, tending to return it to this normal position, increases with the deflection of the needle from this position. The passage of an electric current through the coils C^1 C^2 tends to swing the needle to a position parallel with the axis of the spool *C*, but the torque exerted decreases as the needle approaches that position. When the opposite force of the magnet and the coils balance each other the needle comes to rest, and the index points on the scale to the number indicating the voltage of the current. The currents induced by the armature *H* in a surrounding shell of copper retard or dampen the movement of the armature, and thus prevent the index from oscillating so much as to render it difficult to get an accurate reading. The push button enables readings to be taken at will, by merely closing the circuit through the coils C^1 C^2. The removable shell enables the needle with the spider and its bearings to be quickly removed for repairs or adjustment, or to permit other shells containing different needles to be inserted.

520,794. Electric Elevator. William D. Lutz, Philadelphia, Pa.

The improvements set as forth in this patent have reference to electric controlling devices for elevators, etc More particularly the invention comprehends certain features or improvements in the controlling mechanism for varying the speed of movement of the car under the action of an electric motor, and permits of the control to be had from the moving car or cage.

520,795. Electro-protective System for Locks. Morris Martin, Malden, Mass.

This invention has for its object to provide an electro-protective system for stores and like places, including a novel lock for the door, comprising a bolt mechanism constructed to be operated by two keys of different make or design. The lock in a certain condition is electrically controlled, so that during the time the lock is so controlled the employes' keys are rendered inoperative. The system also includes a registering mechanism operatively connected to the lock, and located in the office of the store and accessible only to the proprietor.

520,800. Alternating Current Motor. Olof Offrell, Middletown, Conn.

The invention consists of an alternating current motor, having its field magnet core composed of laminations of sheet iron insulated from one another by sheets of paper, the whole being clamped firmly together between end frames of non-magnetic metal, the frames containing bearings for the armature shaft. The construction of the commutator also is novel, and so, too, is that of the brush holders. The field coil is divided into sections, and a switch is provided for connecting these sections either in series or in parallel as desired.

520,809. Means for Preventing Arcing in Electric Power Stations. Elihu Thomson, Swampscott, Mass.

The invention comprises means designed to be used in connection with electric power installation, in which are employed currents of electricity of great volume and considerable potential, such as will maintain arcs across spaces which are separated by only a small interval. This patent is an extension of a former patent issued to the inventor, in which a jet of air is forced between the discharge terminals upon the interruption of an electric circuit.

520,810. Electric Reciprocating Motor. Elihu Thomson, Swampscott, Mass.

The present invention relates to electric reciprocating mechanism, such as rock drilling machines operated by electric currents, and has for its object the production of a vigorous reciprocating machine operated by electric currents with a maximum of efficiency and economy. The invention, while applied directly to rock drills, is applicable to other cases in which it is desirable that a powerful reciprocating movement may be obtained from electric currents. A continuous current is utilized for polarizing the apparatus, and an alternating undulatory current for causing the movable portion of the apparatus to vibrate at a proper rate, the alternating current being caused to have its periods of alternation to correspond with the natural period of vibration of the apparatus. The continuous current is made to set up a circular or transverse field of magnetism, and alternating currents are sent through a movable coil placed in the field, so as to cause vibration of the coil. The construction of the motor is shown in the accompanying illustration, $C\,C^1$ representing the coils, $D\,D^1$ a central core composed of a hollow iron tube, having flanged plates $P\,P^1$, and *H* an outer iron shell. The coils are wound so that the current moves through them in opposite directions, and therefore produces consequent polarity in the center core. Mounted in the annular or transverse field formed, is a movable coil or set of coils *T*, moving longitudinally. This being a movable coil, connections are made by springs, as at *S*, to proper posts for conveying current to the moving coils.

520,811. Electric Meter. Elihu Thomson, Swampscott, Mass.

The invention relates to electric meters formerly patented by the inventor, upon which this invention is an improvement. It has for its object to provide a means for starting such a meter under small loads, and particularly a means of providing an initial field or energy supplying circuit sufficient to overcome the friction co-efficient of such matters as the inventor has previously described. For this purpose is provided, in addition to the series coil of the meter, an auxiliary or shunt coil wound in relation to the armature in such a way as to furnish the field required.

520,820. Signal Light Fixture. William Carter, John W. Dawson and Joseph Meyrick, Jr., Louisville, Ky.

The invention consists of the combination in an electric flash lamp of a valve seat within an outer shell, a gravity valve in the seat, a diminutive channel between the valve seat and valve, and an electro-magnet supported on the outer shell, with its poles in convenient proximity to the valve.

520,822. System of Circuit Control for Electric Machines. Charles E. Davis, Chicago, Ill.

The invention relates to electric starting devices for electric motors, and consists in combining therewith mechanism whereby

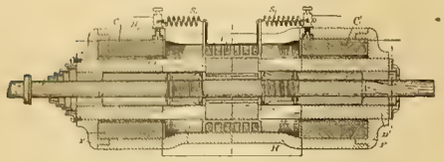
the starting devices may also be used to govern or control the current entering the motor, at the same time being combined with the device, which automatically convert the motors or one of them into a generator, whereby current is produced at the expense of mechanical energy, which, being consumed, causes retardation and final stopping of the motors and connected machinery.

520,855. Feed Wire Insulator. Charles A. Lieb, New York, N. Y.

This invention relates to feed wire insulators, or, more properly, to the cap and cone insulation commonly used to support the feed wires or other large wires upon poles, and has for its object to produce an efficient insulator with a clip or grip for the wire which can be easily attached, and which can be easily and cheaply constructed.

520,852. Electric Switch Box. Edward R. Knowles, Middletown, Conn.

This invention was designed especially for use on searchlights, but it is useful in any situation where the switch contacts must be thoroughly protected. It consists in a double-pole snap switch enclosed in a water-tight box, having an operating handle on the outside of the box.



NO. 520,810.

520,978. Electric Circuit Regulator. Harry F. Waite, New York, N. Y.

The invention relates to electric current regulators, and has for its object more particularly to provide means by which electricity may be conveniently and properly applied in the treatment of diseases, and especially to provide means by which currents of different strengths and kinds may be applied to the patient, and whereby interruptions of the current of various degrees of rapidity can be obtained and controlled. The invention as shown comprises an electric motor *B*, mounted upon an insulated base. Mounted on the armature shaft *C* of the motor is a circuit breaker *D*, consisting of an insulating body, having eight or more metallic plates *d*, arranged upon its surface. *D'* is a brush, and *F* is a pole changer. Connected to the armature shaft is a train of reducing gears *G*, and these are connected to drive the countershaft *H*, having mounted thereon a circuit breaker *H'*, which may be of the same construction as the circuit breaker *D*, and may be provided with one or more contact plates on its surface, and combined with the shaft *H* is a suitable brush or spring arranged to bear on the periphery of this circuit breaker, and both are connected in circuit. By this reducing train it is possible with the same mechanism to produce breaks in the circuit as seldom as is desired, while with the circuit breaker *D* very rapid interruptions or breaks in the circuit can be produced.

520,926. Lever Controlling Device. Arthur H. Johnson, Rahway, N. J.

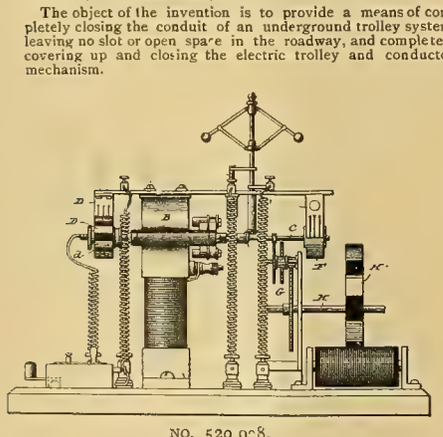
This invention relates to an improvement in lever controlling devices, in which the unlocking of the lever depends upon the closing of the electric circuit which controls the lever-locking device. It is particularly well adapted to practical use in connection with a switch or signal operating lever where it is desirable that a signal for admitting a train to the block should not be permitted to be set to safety until a preceding train shall have passed a predetermined point in advance.

520,937. Trolley Wire Supporter. Louis McCarthy, Boston, Mass.

Means are provided in this invention by which the rigidity of the trolley wire in center pole overhead electric railway construction is avoided. The accompanying drawing is self-explanatory of the invention, 2 being a bracket arm and 3 the trolley wire.

520,938. Closed Conduit for Electric Railways. Paul Pledeck, Sr., Cleveland, O.

The object of the invention is to provide a means of completely closing the conduit of an underground trolley system, leaving no slot or open space in the roadway, and completely covering up and closing the electric trolley and conductor mechanism.



NO. 520,908.

520,940. Dynamo-electric Machinery. Coleman Sellers, Philadelphia, Pa.

One of the claims reads:

A dynamo-electric machine having a vertical shaft carrying a bell shaped revolving field or armature and supported within bearings carried by spider frames detachably secured in concentric bearings upon projections within a cylindrical frame which is provided with projections which rest upon the bed-plate, and which are capable of adjustment thereon to secure alignment with the power shaft without disturbing the determined concentricity of the stationary and revolving parts of the machinery.

520,963. Ammeter. Edward R. Knowles, Middletown, Conn.

The proposed ammeter is an instrument having a bar helix of a particular shape by which the advantages of two coils placed eccentrically are obtained.

520,964. Voltmeter. Edward R. Knowles, Middletown, Conn.

The object of this invention is to enable the field coils to be brought close together so as to nearly surround the needle, and thus give a stronger action thereon. The damping device is placed outside of the coils, and consists of a fan blade in a closed chamber. The strength of the permanent magnet is adjustable by means of a soft iron bridge, and the magnet is set at an angle to the field coils in order to give the needle a longer range of movement.

520,965. System of Electrical Distribution. Benjamin G. Lamme, Pittsburg, Pa.

The invention relates to methods and means whereby the advantages of alternating current transmission can be combined with those of direct current distribution, and whereby, from a constant current generator and at a central station, currents of reduced potential and constant quantity may be obtained on the line. Reduction of potential while usually found convenient, is not, however, an essential feature of the invention. In practicing this invention it is also possible to obtain different potentials simultaneously at different points and keep the current constant at such points.

520,970. Method of Economizing the Energy of Alternating Currents. Charles F. Scott, Pittsburg, Pa.

The invention relates to alternating current systems of electrical distribution where transformers are employed for the purpose of modifying the potential of current supplied at points of translation. The object of the invention is the production of means by which those systems or portions of systems which are run on light load or on practically no load for a large portion of the time may be operated with a minimum loss in iron and copper of the converters.

520,971. Electric Railway Overhead Switch. Miller A. Smith, Brooklyn, N. Y., and William Clabaugh, New York, N. Y.

The object of this invention is the improvement of devices such as switches, crossings, etc., employed in connection with an overhead electric railway and interpolated in the line of the overhead wire.

520,975. Converter System for Electric Railways. George Westinghouse, Jr., and Charles F. Scott, Pittsburg, Pa.

The invention has relation to improvements in a former patent in which an alternating current of high potential is generated at the power station and conveyed to properly placed converters in which the potential of this current is reduced, and the secondary circuits are employed for driving motors upon the cars. The object of the invention is the provision of means by which the sectional conductors when not employed in feeding the car motors may be supplied with an extremely low potential by which, when the motors are being fed from any given section of working conductors, the potential supplied thereto may be raised gradually above that supplied when the conductors are not active. By these means the leakage under normal circumstances is greatly reduced, and particularly in those cases in which the return is through the rails or earth.

520,991. Electric Arc Lamp. Louis E. Howard, Plainfield, N. J.

The inventor surrounds the light-giving portion of the lamp with a glass or other transparent enclosing chamber, which, in the case of an arc, would be preferably made substantially air tight, and exposes the walls of this chamber to certain metallic vapors, by which process it is uniformly coated with a thin film of a metallic oxide, or other compound, which will, on transmission of light through it, create uniform diffusion, and when the containing envelope is sufficiently small will be rendered phosphorescent or self-luminous.

520,996. Electric Arc Lamp. Louis B. Marks, New York, N. Y., and Clarence Ransom, Passaic, N. J.

The invention is designed to admit of operating an arc lamp placed directly across a pair of constant potential mains at the voltages ordinarily employed without the interposition of idle resistance, and without wasting energy by permitting a current of great amperage to flow through the lamp. This result is accomplished by establishing between the electrodes a drop of potential sufficient to admit of a small flow of current, and by providing means by which such an arc may be continuously maintained so as to insure the operation of the lamp.

521,010. Conduit Electric Railway System. James B. Brand, Milwaukee, Wis.

An underground conduit system is illustrated in this patent, in which *A* of the accompanying drawing, which is a longitudinal sectional view, is a slotted casing or tube, to be placed underground between the tracks. *C* designates a suitable pipe supported as indicated, at *c*. The conductor *D* is embedded in an insulating material *E*, located in the lower part of the pipe. *F F* are vertical tubular connections, through which plungers *G G* extend, carrying at their lower ends contact shoes *g g*. To the upper ends of the plungers *G G* are secured sections *K K* of the service rail, the sections being pivotally engaged with the upper ends of the plungers. It will be seen by the drawing that, as the car advances, the contact device *B* is brought into engagement successively with the several sections of the service rail, these sections being depressed and brought into connection with the conductor *D* as the contact device advances, and but one section *K* of the service rail being in circuit at one time. As soon as the contact device has passed from one section of the service rail into engagement with the next adjacent section the springs supporting the plungers connected with the first mentioned section will serve to automatically raise the plungers and the movable sections, so as to break the electrical contact between the plungers and the conductor.

521,018. Connection for Electric Wires. James Y. DeMott, Newark, N. J.

Claim 1 reads:

An improved electrical connection or joint comprising a plate of conductive metal bent longitudinally at the center to form a raised rib, and having its opposite edges turned on to the rib and forming a joint.

Another claim reads:

The combination with the overlapping wires of a sheet metal plate centrally bent to form a ridge which hugs the sides of the wires and extends to a point substantially in line with the centers of the wires, the opposite edges being turned over the wires onto the rib, and the whole being crimped transversely to hold the parts together.

521,046. Electrical Annunciator. Frederick W. Ross, Boston, Mass.

This invention relates to electrical annunciators in which an index hand is controlled by a lever, and the movements of the lever are controlled by the armature of a single electro-magnet to release the lever, and thereby move an index finger, the apparatus being replaced by means of a lift.

521,051. System of Electrical Distribution by Alternating Currents. Charles F. Scott, Pittsburg, Pa.

The invention involves a system of electrical distribution in which multiphase currents of different numbers of phases are employed, and a novel method of and apparatus for accomplishing the change from one number of phases to another number of phases.

Claim 2 reads:

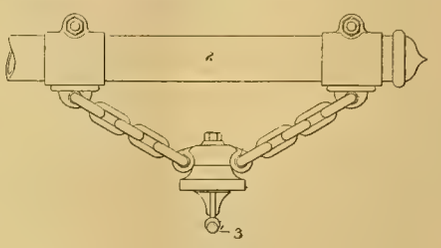
An apparatus for the transformation of two-phase alternating currents to three-phase alternating currents or vice versa, consisting of the combination of two alternating current transformers, the ratio of the length of a coil of one transformer to the length of the corresponding coil of the other transformer being approximately that of one to one-half the square root of three, and electrical connections from one terminal of the shorter of the coils to approximately the middle point of the other of the coils.

521,065. Electric Alarm Clock. John S. Whitehead, Detroit, Mich.

The invention consists principally in the novel arrangement of a circuit-closing device consisting of an electric break formed of two self-closing metallic contacts forming part of the circuit and an insulating lever adapted to hold the break open in one position, and to be moved out of this position by the operation of the mechanical alarm, the arrangement being such that the electric current is closed without passing through the clock frame.

521,085. Electrical Governor for Water Wheels. Carl S. English, Lowell, Mich.

The invention has for its object to provide novel mechanism for automatically regulating the supply of water to a water wheel that is utilized to generate power for an electric dynamo, in such manner that the amount of water supplied to the wheel, and consequently the power developed by the wheel, shall be increased and diminished in proportion to the amount of work required to be performed by the dynamo.



NO. 520,937.

521,089. Electric Meter. Warren B. Reed, New Orleans, La.

It is the purpose of this invention to provide and combine with a meter for measuring and registering the consumption of current upon lamp circuits, the speed of which is variable in proportion to the varying consumption of the current, means whereby the latter may be used in connection with the regular three-wire Edison circuit with correct indications under both normal and abnormal conditions.

521,099. Electric Heating Apparatus. George D. Burton, Boston, Mass.

Claim 1 reads:

In an electric heater the combination of a central hub attached to one terminal of the converter and provided with means for receiving one end of the rod to be heated and an arc-shaped conductor attached to the other terminal of the converter arranged to swing radially toward and away from the central hub, and provided with a jaw arranged to hold and make contact with another part of the rod to be heated.

521,124. Section Insulator. Herbert B. Nichols and Frederick H. Lincoln, Philadelphia, Pa.

The principal objects of the invention are to provide a simple, durable and effective section insulator for the conductor of an electric trolley system, to provide a section insulator with means adapted to readily permit of the establishing of a circuit by the formation of a bridge over the device, and to provide a section insulator in which the construction and arrangement is such that the momentum acquired by the motor car in its travel will carry it over the break in the line established through the insulator by its interposition in the main conductor.

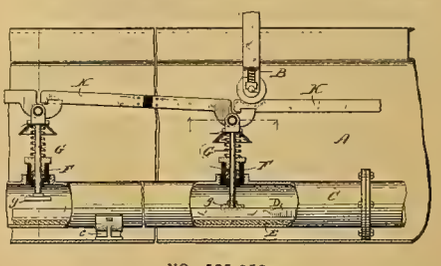
521,125. Electric Subway. James J. E. Philips, Brooklyn, N. Y.

The primary object of this invention is to place conductors or cables in a duct or conduit, without undue or injurious friction to the conduit or cable or to the conductors or cables already laid, and without the necessity for the use of complicated and expensive supporting mechanism apparatus for operating it.

521,131. Incandescent Lamp. Detlef C. Voss, Boston, Mass.

Claim 1 of this invention reads:

A cement plug wire holder for incandescent lamps composed of the metallic oxides of lead, alumina and manganese, high in



NO. 521,010.

oxygen and mixed, fused and blended by heat into a homogeneous cement free from silica, potash and soda of lime.

Another claim reads:

An incandescent electric lamp composed of an incomplete glass receiver in combination with and united to the surface of an insulating plug which carries in and surrounds the leading-in and filament carrying wires.

521,138. Electric Motor for Dental Engines. W. A. Crowdus, Chicago, Ill.

The object of this invention is to provide an electric motor of suitable construction adapted to drive, engage with, and operate a dental engine head and means by which it can be quickly stopped from rotation when the current is shut off.

521,144. Annunciator. Thomas J. Thompson, Chicago, Ill.

The invention consists in an electric annunciator of the combination with the single spool of a core provided with projecting ends forming the pole pieces, adjustable screws inserted in the end faces of the poles, the armature loosely mounted on the screws and provided with a notch, the latch being rigidly mounted upon the same shaft with the pointer or indicator, and a stud forming the bearings of the shaft, this shaft being cut away to admit the latch and permit its rotation.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, JUNE 23, 1894. No. 25

Electrical Power Transmission at West Pullman, Ill.

In the vicinity of Chicago, and probably in the whole West, there is no more notable factory plant for the transmission of power by electricity than that recently put in operation by the Whitman & Barnes Manufacturing company of West Pullman, Ill. The plant is conspicuous not only for its size and for the number of motors, but also for the absolute reliance placed upon it to supply the power for a large manufacturing concern. The factory is a new one, and the establishment comprises thirteen buildings located on several acres of ground just west of the city line of Chicago. The Whitman & Barnes company manufactures wrenches and harvesting knives, and its older factory is at Akron, O. The building of the large establishment at West Pullman is a significant indication of the western movement in manufacturing and of the growth of Chicago as a great manufacturing center. In erecting its western factory the company has exhibited a very evident determination to start out with the best facilities attainable. The buildings are handsome and solidly constructed of brick, generously supplied with windows. The sanitary, heating and ventilating arrangements have been carefully planned, and each workman is furnished an individual wardrobe and has at his disposal bath and toilet conveniences which would be a credit to many a hotel. In the method of power transmission the management has manifested the same spirit of enlightenment and progress as in other departments, and the power for nearly all the machinery is electrically transmitted.

The engine and dynamo room, or central power station, is illustrated in Fig. 1. In the foreground is a lighting dynamo directly coupled to a Ball & Wood simple engine of 100 horse power operating at 300 revolutions per minute. This dynamo is a 110 volt multipolar machine of 65 kilowatts capacity and supplies current to about 1,000 16 candle power lamps in the various buildings. Back of this engine-dynamo, as seen from the spectator's point of view in Fig. 1, is the big power generator, which is shown separately in Fig. 2. This generator is of the largest type made by the Eddy Electric Manufacturing company, and, operated at a speed of 200 revolutions per minute, has a capacity of 200 killowatts. It is supplied with compound winding for a potential of 500 volts and has four poles. It is directly connected to a 300 horse power tandem compound engine made by the Ball & Wood company. Steam is supplied by a battery of boilers in an adjoining room, crude oil being used as fuel. Pure water is secured from artesian wells on the premises.

As all the electrical power is generated in one machine, the whole factory practically depending upon it, the necessity for such a large and solidly built generator as that shown in Fig. 2 becomes apparent. The machine stands eight feet from the floor and weighs 40,000 pounds. The armature is of the modern ironclad type, with solid copper bars insulated from the core and from one another by mica and paper. The construction is such that in case of accident one or two bars may be removed without disturbing the others and the necessary repairs easily made. The field poles are of cast-steel, bolted to a cast-iron frame. The coils are wound upon galvanized iron spools with brass heads, and these spools are supported away from the pole pieces in such a manner as to permit free circulation of air to their inner as well as outer surfaces. The base and pillow block boxes are cast with the lower half of the magnet to secure greater rigidity.

The small two-pole 110 volt dynamo shown in Fig. 3 is really a portion of the engine room equipment, although installed in another room. It is designed to be driven by a belt from a line of overhead shafting not shown in the picture, but has not yet been placed in operation. It can carry 100 lights and will be used for light loads in the daytime when it may be desirable to burn a few lamps about the factory without starting the larger lighting dynamo. This small machine is controlled from the engine room switchboard. This board, shown in Fig. 1, is ten feet long and seven feet high. It is of brown Tennessee marble, trimmed with white marble, and contains, beside the necessary switches, cut-outs, rheostats and ground detectors, two ammeters and two voltmeters, with illuminated dials, of the Weston station type, and two Thomson recording wattmeters, from which readings are taken every day and preserved, to show the daily output of current in comparison with the amount of fuel consumed.

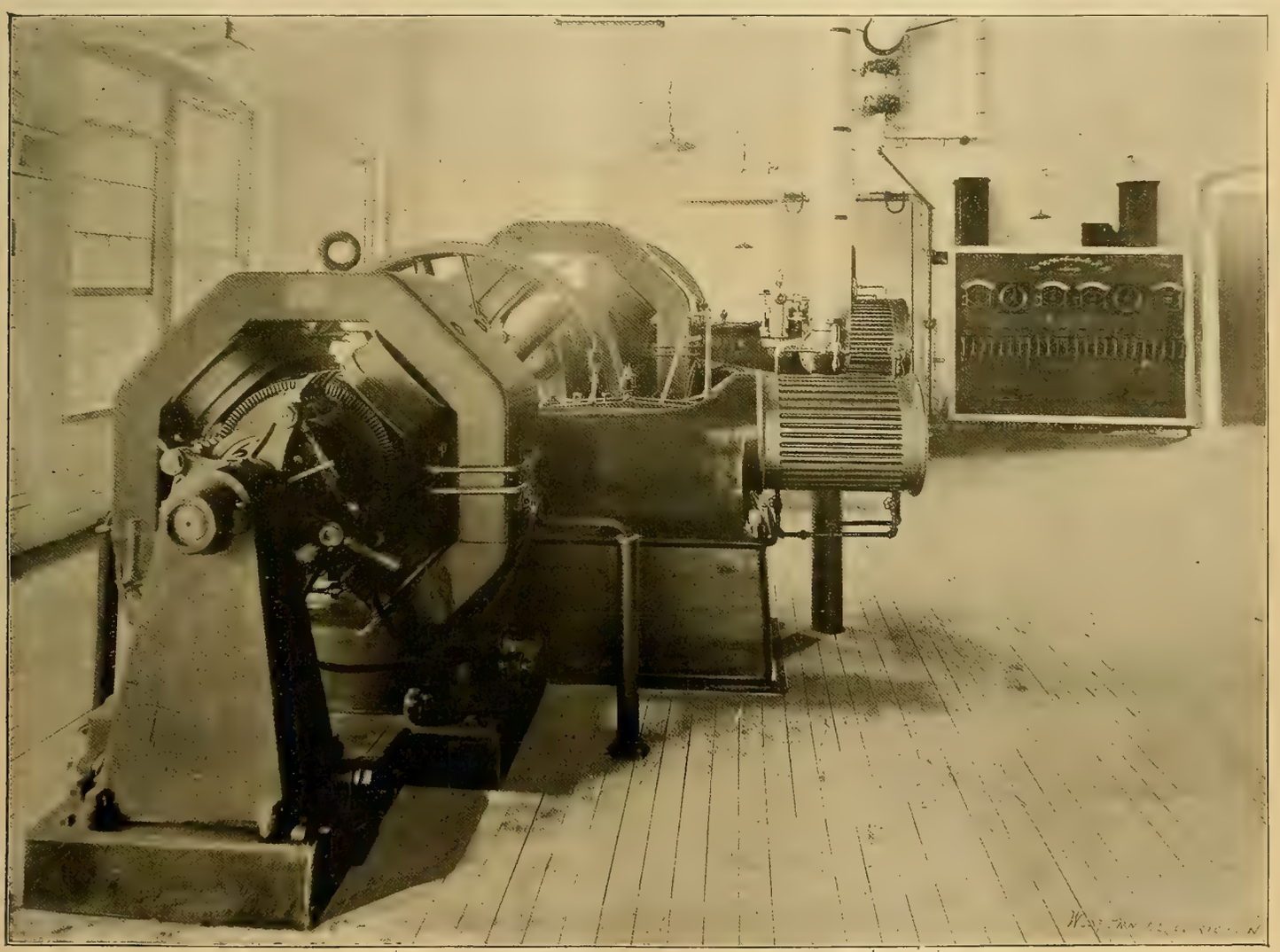


FIG. 1. ELECTRICAL POWER TRANSMISSION AT WEST PULLMAN.—ENGINE AND DYNAMO ROOM.

Eight power feeders and four light feeders comprise the main branches of the wiring system. From the switchboard the feeders are laid underground in vitrified tile to eight centers of distribution, terminating in cut-out cabinets built in the latest and most approved manner. The wiring plan has been so well caculated that there is only a difference of 1½ volts in potential between any two motors, although some of them are as far as 800 feet from the switchboard. All inside wiring is overhead work, the power conductors being supported on glass insulators, while the light wires are run on porcelain. The incandescent lamps are all wired on drop cord and furnished with tin shades or guards.

Thirty-two Eddy motors, ranging in size from one to fifty horse power, are supplied with current by the big generator. These motors furnish the power for nearly all the machinery in the factory, and are scattered throughout all the buildings. In the the forge room, for instance, there are two 50 horse power motors attached to either end of a long line of overhead shafting. A picture of one of these large motors is given in Fig. 4. In the grinding room there is also a 50 horse power motor, which drives a set of grinders, as well as a 25 horse power machine employed for a similar purpose and a motor of 5 horse power capacity used to operate a suction fan. Nearly all except the largest motors are suspended on hanging platforms and are belted directly to main shafts, from which power is supplied to different groups of machinery. A good example of this is shown in Fig. 5, which represents the wrench department, where, in one room, three 30 horse power motors supply the needed power to the shafting. All the motors are furnished with automatic starting boxes, and double pole snap switches for

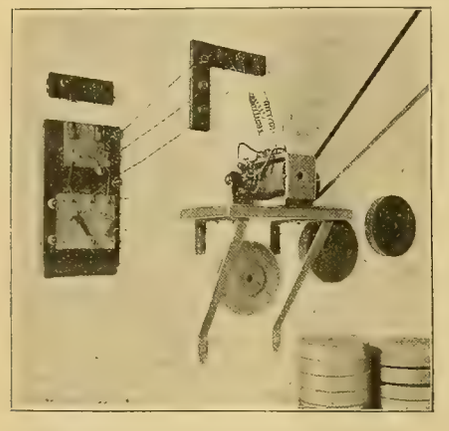


FIG. 7. ELECTRICAL POWER TRANSMISSION AT WEST PULLMAN.—THE SMALLEST MOTOR.

each motor are placed conveniently within reach from the floor. By this arrangement the motor can be stopped quickly in case of accident, while in starting the operator must ascend to the platform, in the case of the larger overhead machines, and satisfy himself that the motor is running properly before be leaves it. To enumerate all the uses to which the motors are put in this factory would be to give a catalogue of the power machinery employed by the Whitman & Barnes Manufacturing company. In the wood working department there is a 15 horse power motor; in the machine shop one of 20 horse power and another of 15; in the machine repair shop a 20 horse power machine, and so on. Five elevators in various parts of the factory are operated by as many belt-connected motors, a typical installation of this character being shown in Fig. 6. In several cases smaller motors are employed to drive single machines, usually by belting and a countershaft. Thus a 15 horse power motor runs a 600 pound drop hammer; a big shear designed for cutting 2½ by ½ inch iron rods is operated by a 5 horse power motor placed on the rafters directly above; a large double stamping and cutting press is run by another 5 horse power motor set similarly on the rafters, and an oil pump is run by a 3 horse power motor. In the instance last cited a one horse power motor was at first employed, and for six weeks it bravely carried a load of two and one-half horse power before burning out. In the emery polishing room is one of the smallest motors, Fig. 7. This is only one horse power and drives a light line of shafting.

The efficiency and economy of this plant are very satisfactory. With a total rated capacity of motors amounting to 546 horse power, the average consumption of electrical energy is only 95 kilowatts per hour, or 126½ horse power. With a loss in transmission of 2 per cent. and an efficiency loss in generator of 4 per cent., it only requires 134 mechanical horse power to supply the average of power required. If belts or rope transmission had been adopted and calculated for the total capacity of machinery, the bulk of which is operated at a distance of 500 feet from the steam plant, it would have required an output of 201 mechanical horse power to transmit the required 126½ horse power. Work on the plant was begun January 2d, and the work was practically completed in April. A thirty

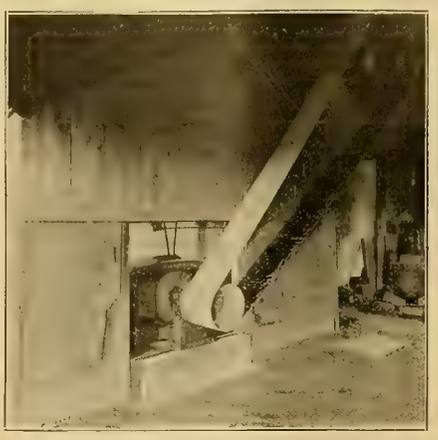


FIG. 4. ELECTRICAL POWER TRANSMISSION AT WEST PULLMAN.—50 HORSE POWER MOTOR IN FORGE ROOM.

days' test was required and given, and the plant is now in successful operation.

The electrical equipment was furnished by the Eddy Electric Manufacturing company, while all of the construction work, including the switchboard, was supplied by Gustave Monrath, who held a sub-contract under the Eddy company.

Canadian Interests at Niagara Falls.

The commissioners of the Queen Victoria Niagara Falls park and the officers of the Canadian Niagara Falls Power company met on June 9th. At this meeting the plans for the development of the great water power on the Canadian side of the Niagara river were submitted by the power company and accepted by the commissioners. The contract and necessary papers were signed, and a corps of engineers is staking out the pit and the site for the power house under the hill on which stands the Loretto convent. The plans in many details are similar to those on this side. A power house and the first excavations for pits will be of similar dimensions. Three turbines of the same size as those on the American side will be put down, and the arrangement will allow the pit to be extended 1,200 feet if it should be desired. Work on the wheel pit and the shot tunnel and canal will be begun at once, it is said, and pushed to completion.

Convention of Railroad Telegraph Superintendents at Detroit.

The thirteen annual meeting of the railway superintendents of telegraph of the United States and Canada was

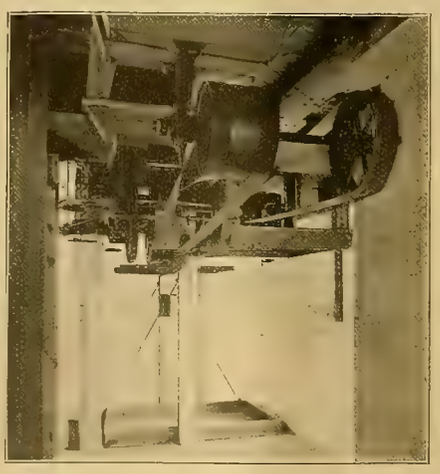


FIG. 6. ELECTRICAL POWER TRANSMISSION AT WEST PULLMAN.—ELECTRICALLY OPERATED ELEVATOR.

held in Detroit, beginning June 13th. About 70 of the leading railway systems of the two countries were represented. O. C. Green was chosen president and E. R. Adams vice president, while P. W. Drew was re-elected secretary and treasurer. A number of interesting papers were read before the convention, and much of the time was devoted to an inspection of some of the electrical and engineering points of interest near Detroit. The next convention will be held in Montreal, June 14, 1895.

Power Transmission at Tivoli.

Prof. J. A. Fleming, lecturing before the Royal Institution, London, described the interesting plant from which 2,000 horse power is electrically transmitted from the Falls of the Anio, Tivoli, for 18 miles over the Campagna to Rome. From the upper levels of the Anio an aqueduct has been, led which delivers water to the top of an iron pipe 150 feet above the power house. This power house is placed about halfway down the declivity on which are situated the famous cascades of Tivoli. The pipe is about two meters in diameter and can deliver 100 to 150 cubic feet of water a second with a head of 150 feet or nearly 2,000 horse power. The water is conducted to a series of nine Girard turbines, six being of 350 and three of 50 horse power. The six larger ones are directly connected with Ganz alternators, which generate a current of electricity at a pressure of 6,000 volts, while the three smaller ones are used to drive the exciters. The current is conveyed to Rome by four cables carried on 760 posts, which are placed in a straight line across the Campagna. Outside the Porta Pia at Rome it enters a transformer house, where its pressure is reduced from 5,000 to 2,000 volts. Part is then used for arc lighting in the streets of Rome, and the rest is distributed by underground cables to various other centers, where it is again transformed down to a pressure of 100 volts for use in houses.

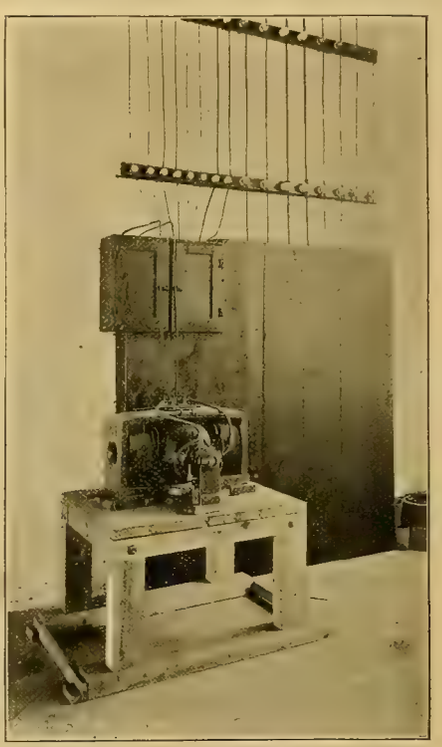


FIG. 3. ELECTRICAL POWER TRANSMISSION AT WEST PULLMAN.—AUXILIARY LIGHTING DYNAMO.

About 20,000 Incandescent lamps are thus supplied with current.

Electrical Plant Needed at Messina.

According to the United States consul at Messina, an electric plant is needed in that city, where at the present time the gas company has no competition whatever. In the course of his report Consul Caughy says:

The light furnished and the prices charged [by the gas company] are both causes of great dissatisfaction to the people of Messina. The power is of only 8 candles, and it costs about $1.92 (gold) per 1,000 cubic feet. It appears to me that there is here a great opportunity for any enterprising electric light company, for in Italy, as well as in the United States, the people are very willing to adopt the latest and best illuminant.

For the installation of a plant for lighting stores and dwellings and the furnishing of motive power the prospects are equally favorable. The usual place of abode in Messina, as in the majority of other European cities, is the apartment, or what we know as the "flat." The walls here are never less than two, sometimes three feet thick, and are built of stone, so that the introduction of gas pipes on any floor except the first, where the connection is made from the street, is attended with so much labor and expense that very few houses, except those recently built, in which it was carried during construction, are provided with it.

As to motive power, there is one applicant already in the field, willing to adopt it as soon as it is installed, and that is the tramway company, which runs its lines from Messina to Faro Point, a distance of 9 miles, and to Barcelona, a distance of 30 miles. At present the road is operated by dummy engines.

I realize that the first questions that will arise are, What will be the cost of constructing a plant and what will coal cost? When I say that the average price for unskilled labor is 35 cents, and for skilled 45 cents per day; that the laying of stone, including cost of material, is 50 per cent. cheaper than brick; that lumber is no more expensive than in the United States; that land is remarkably cheap, and

that Cardiff coal costs, delivered on the wharf, $4 per ton, I think the questions are satisfactorily answered.

Before writing this report I made a thorough canvass of the business men of the city, and they, without exception, promised their most earnest co-operation, both with their influence and their purses, to make the installation of an electric plant in Messina a success.

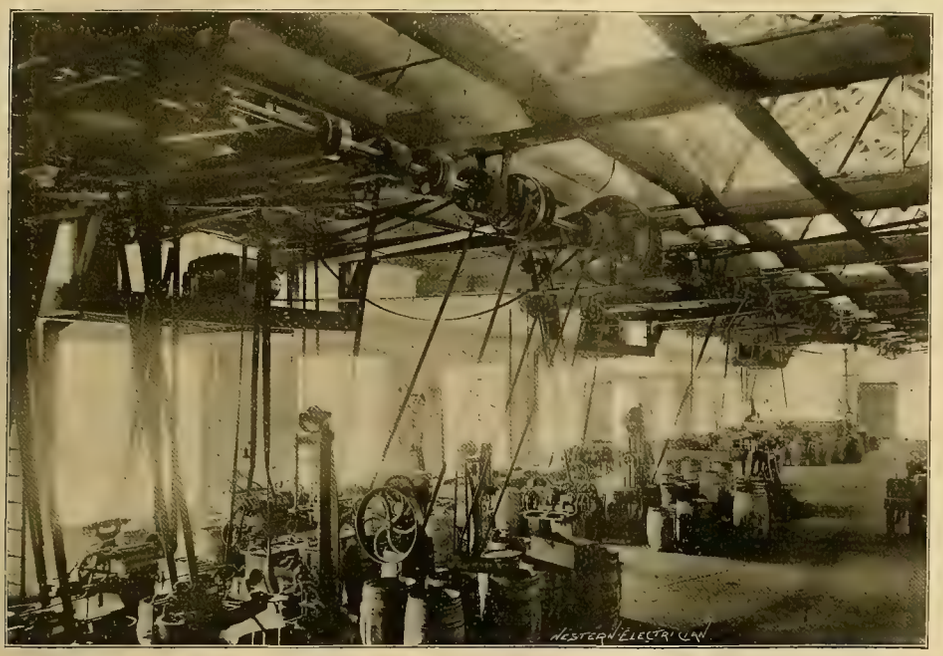


FIG. 5. ELECTRICAL POWER TRANSMISSION AT WEST PULLMAN.—THREE 30 HORSE POWER MOTORS IN WRENCH SHOP.

Electrical Omnibus Experiments in London.

Ever since 1888 experiments with electrically operated omnibuses have been in progress in London. Sufficient advancement has now been made, it is claimed, to warrant the practical operation of a line. One of the early runs was over a distance of nearly four miles, taking 35 minutes, and the experience which was gained in its working demonstrated that the knowledge necessary for running it could be picked up by an ordinary cab or omnibus driver in a few days, no greater care being required to handle such a vehicle with precision and safety than was necessary in the case of a horse bus or cab. Each car, it is calculated, could easily make six 14-mile trips per day, or a total of 588 miles per week per car. The new car is a full-sized, 26 passenger omnibus. It has two batteries of accumulators, each weighing about 1,700 pounds. They are placed under the seats.

Telephoning Through Sea Water.

In 1892 Dr. Ernst Huber of New York patented a sea telephone and a company was formed to construct it. The government took considerable interest in it, and offered Dr. Huber the privilege of using a man-of-war on his experiments. The invention attracted considerable attention at the time, but for some reason the proposed experiments were not made. Dr. Huber turned his attention to other things, and the invention was forgotten. Before getting his patent Dr. Huber made some successful experiments with his apparatus. In the Huber sea telephone the sound waves passing through the waters cause metal strips to vibrate, and the vibrations are transmitted by wires to microphones, which greatly intensify them. A device called an indicator shows the intensity of the sound vibrations and this gives an idea of the distance of the object causing them. By turning the apparatus, which is intended to be attached to the bottom of a vessel, the direction from which the sound comes can be determined. By an ingenious device all sounds made by the ship itself are eliminated, and only those made by extraneous bodies are felt and recorded. By ringing an electric bell attached to the apparatus, sound waves are spread in all directions and are reflected back upon meeting an obstruction. When they are reflected back it is said that they effect the membrane of the apparatus, and give notice of the approaching danger. Icebergs and submerged wrecks can be detected in this manner. The inventor declared that he was able with his apparatus to discover the presence of any obstruction within ten miles.

Windmill Power for San Francisco.

In discussing the possibility of introducing windmills for driving dynamos and storing the energy in secondary batteries, the *San Francisco Bulletin* remarks: "The wind blows from one quarter or another most of the time in San Francisco. There are numerous uses for light and occasional power in a large city. Many more uses would be found for it if the power were at hand on cheap terms. A windmill would work nearly twenty-four hours in the days on an average here. It would be storing up electrical power, while the city was sleeping, for the activities of the next day. It would be doing the same during the day while a great deal of light machinery was in action or during the pauses in its service. Windmills on exposed points in and about the city would furnish a big aggregate of accumulated electric power. For that matter, almost every housewife could run her sewing machine or any other piece of machinery which might be adapted to household wants by electric power, generated by a windmill in the back yard or on the housetop."

Standardizing Electrical Measuring Instruments.[1]

By Elmer G. Willyoung.

The necessity of a complete outfit of proper measuring instruments, voltmeters, ammeters, ground detectors, etc., as a factor of economical operation in all kinds of lighting and power systems, is now almost universally conceded, and we find such instruments all over the country in vast numbers. In the stations we have the station instruments; for general all-round testing work, measuring drops, joint and switch resistances, etc., the portable instrument is useful.

As at present made, all of these instruments have in them dangerous elements of change. If the instrument has a permanent magnet, then the strength of its magnets is liable to be seriously affected in time by the perpetual jars and vibrations to which it is subjected; proximity to strong fields, especially if variable, will tend to produce similar results. Any instrument containing springs is also likely to vary in its indications in time through slow changes of elasticity in the springs, be they ever so carefully gauged. A hot wire instrument may change on account of the change in radiating quality of the surface of the working wire produced by its slow oxidation; molecular changes in the wire are also liable to go on when continually heated, since our experience with standard resistances shows us that changes of this kind do go on very slowly even with wires kept at normal temperatures. And so of any type of commercial instrument which may be mentioned—none of them can be absolutely trusted not to change.

This being so, we must, therefore, frequently examine these various instruments and determine if such changes have taken place, and, if so, what has been their magnitude. As a rule this is done at present not by the owner of the instrument, but by the instrument maker, the instrument being taken down and sent back to the maker from time to time for recalibration, or, if they are not, they should be. This in itself is expensive—express charges must be paid; time must be spent in correspondence; often, if not always, a charge is made for the work of restandardizing. Not only this, but there is no surety whatever that these restandardized instruments may not again "get out" while on their way back to the owner, as the sharp "high frequency" jars of transit are known to be very hard upon magnets and fine mechanism.

Consideration of the foregoing long ago convinced me that this restandardizing should be done by the stations themselves in all cases except when quite small, and that some arrangement of apparatus should be devised which would make the utilization of some absolute standard method inexpensive and convenient, and possible to any one of ordinary intelligence. After a good deal of thought and personal experience, I became convinced that the only method which could be made to at all satisfy these requirements was the potentiometer method. Before speaking specifically of the improved apparatus which I have devised for the commercial utilization of this method I wish to discuss briefly the potentiometer method in general and to outline what I consider its advantages over all other methods.

THE POTENTIOMETER METHOD.

Broadly, the potentiometer method consists in opposing some known proportion of the drop of an unknown electromotive force through a given resistance to a definitely known electromotive force, the proportion being so chosen that no current is produced by the latter known source. This condition being established, an equation involving

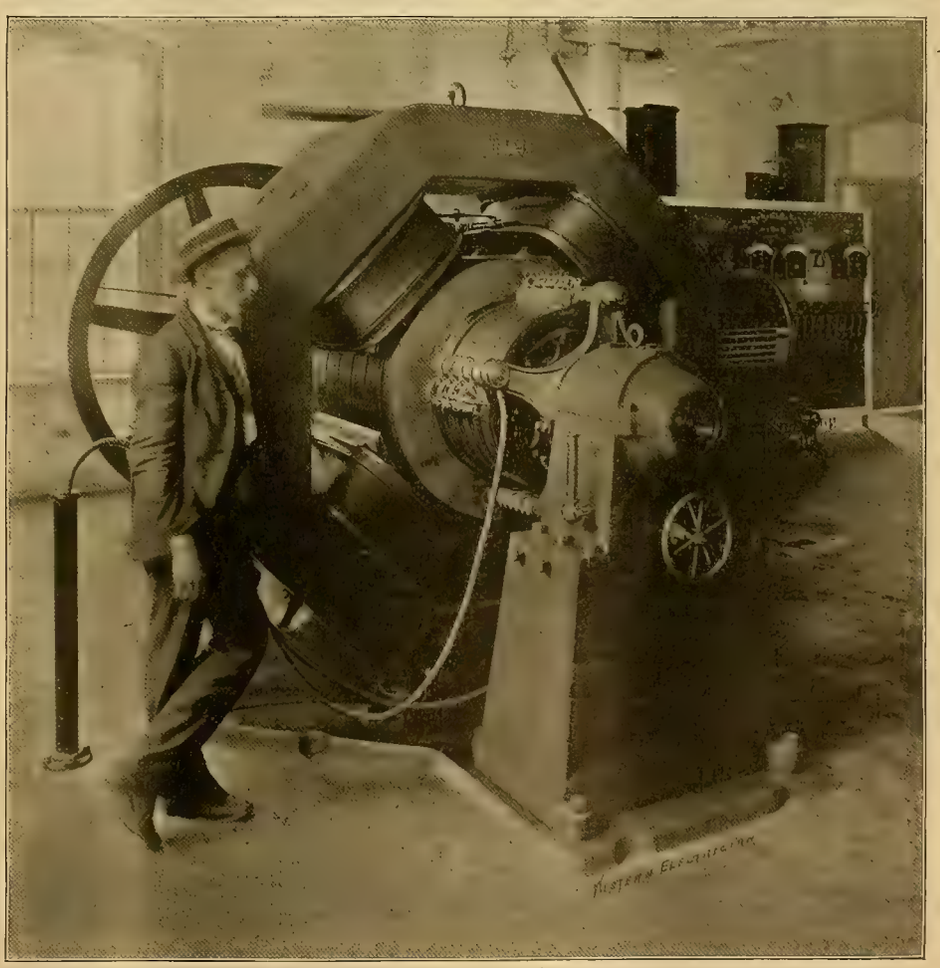


FIG. 2. ELECTRICAL POWER TRANSMISSION AT WEST PULLMAN.—200 KILOWATT GENERATOR.

1. Abstract of a paper read before the American Institute of Electrical Engineers, Philadelphia, May 17, 1894.

be unknown electromotive force as the only unknown quantity immediately obtains. The method in general is fairly well known, being variously called the standard cell method, the Poggendorf or Rayleigh-Poggendorf compensation method, the Rayleigh method, etc.; it is not by any means so widely known, however, as it deserves to be.

Diagrammatically, the method is represented in Fig. 1. Here $A\ B$ is a wire of high resistance and any desired length stretched between two fixed points. B_a is the battery whose unknown electromotive force we desire to know, supposed higher than that of $S.\ C.$, which is a known standard cell. In series with $S.\ C.$ is a galvanometer, G_a. B_a and $S.\ C.$ are so placed as to oppose one another so

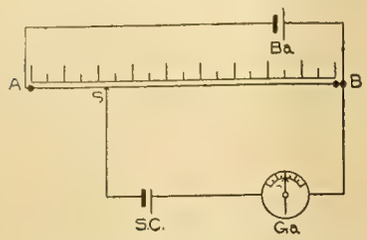


FIG. 1. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

that when the circuits are closed a position, S, of the slider upon the wire may be found such that the fall of electromotive force of B_a between S and B, will exactly equal the electromotive force of $S.\ C.$ There will then be no deflection of G_a, and we will have

$$\frac{E_{Ba}}{E_{S.C.}} = \frac{A\ B}{S\ B} \text{ or } E_{Ba} = E_{S.C.} \frac{A\ B}{S\ B} \quad (1)$$

an equation involving only a known electromotive force and the ratio of two lengths. The resistance $A\ B$ should, of course, be chosen so large that the internal instance of B_a is negligible as compared with it. In practice this form of the method is commonly known as the Rayleigh or Rayleigh-Poggendorf compensation method; and instead of a straight wire, $A\ B$, this is equivalented by two resistance boxes of about 5,000 ohms each. This arrangement is shown in Fig. 2. Plugs are removed in R and R_1 so as to have in all a total of, say, 5,000 ohms out. This total is maintained constant, whatever plugs are taken out of one box being inserted in another. When a balance is secured, the resistance in the two boxes must be counted up and then equation (1) applied.[1]

This arrangement of the method is very suitable for making comparisons of standard cells, B_a being merely any form of constant battery. A balance having been secured for $S.\ C.$ it is then removed and another standard cell, $S_1.\ C_1.$, substituted; a new balance is then gotten. By properly choosing B_a and the total of R and R' the resistance, R_1, in the standard cell circuit may be made about 10,000 ohms, so that for each ohm difference in balance between different cells a difference of .01 per cent. is signified. If a properly sensitive galvanometer be used a variation of one ohm from balance is very easily seen. This arrangement is also very accurate and easily used in determining the temperature coefficient of a cell, the cell being surrounded by a water bath, and balance being obtained for different temperatures.

A modification of this method was proposed some years ago by Dr. Fleming, and is shown in Fig. 3[2]. It is, as is evident, exactly the same as Fig. 1, save that a resistance, R, is inserted in the main circuit. Here B_a, instead of being the electromotive force to be measured, is merely any fairly constant source, such as, *e. g.*, a cell of storage battery. The wire, $A\ B$, is stretched along a scale uniformly divided into, say, 150 parts, 100 of which are then made to correspond to a fall of B_a of one volt by adjusting S to a position corresponding to balance, if this assumption were true, and then making it true by an adjustment of the variable resistance, R. If $A\ B$ is so great that the current produced by B_a is small compared with its normal discharge rate, then the difference of 1.5 volts between A and B may be assumed constant for a considerable period, especially as the circuits should be closed only long enough for balance. Any inconstancy may be immediately detected by placing S at the balance point. Balance should persist without further adjustment of R. To measure any unknown electromotive force now, $S.\ C.$ is simply removed, and the unknown source substituted for

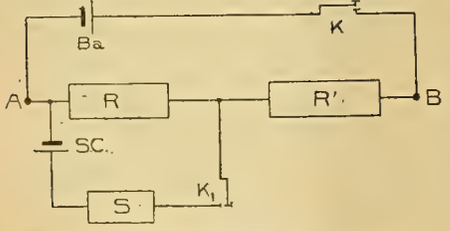


FIG. 2. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

it. If this source is less than 1.5 volts, then a position of S will be found, at which there will be balance, and the number of parts between S and B will give the electromotive force directly by pointing off two places of decimals. Should the electromotive force be higher than 1.5 volts, then it may be placed in series with a high resistance, and the electromotive force over a portion only of this resistance measured. The two place reading of S multiplied by

$$\frac{\text{whole of high resistance}}{\text{portion of high resistance in derived circuit}}$$

will again be the unknown electromotive force, desired.

Not only may we thus measure electromotive force but by arranging as in Fig. 4, we may also measure current by this method if we know the resistance of shunt S. Similarly, we may measure resistances by comparing the fall of electromotive force around a known resistance with that around the unknown resistance placed in series with it, a constant current being maintained through both.

The advantages of the potentiometer are:

(1) It is a zero method; a calibrated galvanometer is, therefore, not necessary.

(2) Accuracy depends only upon a standard cell and a standard resistance, and results obtained by the best authorities over a number of years show that both of these may be relied upon within extremely small limits of error, with proper treatment, for a practically indefinite time.

(3) It requires but simple apparatus, always obtainable, and ordinary care. It can be used without inconvenience in regions of great mechanical instability and of intense and variable magnetic fields.

OTHER METHODS OF STANDARDIZING.

The advantages of the potentiometer method can, perhaps, be better appreciated by briefly recapitulating the other possible methods. These are but few in number. We have:

THE VOLTMETER METHOD.

This depends upon the maintenance of a steady current for at least 20 minutes or half an hour through an electrolytic solution, usually silver or copper, and an accurate weighing of the amount of decomposition thus produced.

THE DIRECT INSTRUMENTAL METHOD.

Here the values must be obtained by direct measurement with instruments which do not contain elements of change. About the only instruments satisfying this condition are the tangent galvanometer in some form or other and the Thomson balance.

THE TANGENT GALVANOMETER.

Disadvantages:—(a) The instrument must be very accurately constructed and hence is costly.

(b) To secure accuracy the instrument must have a suspended system, which is liable to continual breakdown and is difficult of repair except by an expert.

(c) Accuracy depends upon the constancy of H, the

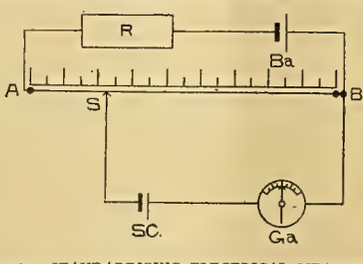


FIG. 3. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

horizontal magnetic component; this depends upon local conditions and varies with change in position of neighboring magnetic materials and with the temperature of fixed masses of such metals.

(d) Indications are greatly affected by variable currents or magnetic fields in the vicinity.

(e) Mechanical stability must be had; hence such an instrument is difficult to use in stations or localities where mechanical vibration is large.

(f) The instrument must be very carefully adjusted in the first instance; this requires considerable time and skill. It must, therefore, be permanently set up in combination with the observing telescope or lamp and scale in a room or part of a room which must not be used for any other purpose in order that the outfit may not be disturbed.

THE THOMSON BALANCE.

This instrument is much superior to the tangent galvanometer, requiring much less skill in use and practically no adjustment. It is not affected by being moved about from place to place if carefully handled and is not appreciably varied by magnetic changes of small amount.

Disadvantages:—(a) It is affected by fluctuating currents or fields of large value if very near.

(b) A large number of instruments is required to cover very much of a range of measurement, any one instrument only measuring within limits of 1 to 100, as *e. g.*, from 1 to 100 centi-amperes, 1 to 100 amperes, etc.

(c) It is slow, but one value being obtainable in this time.

(d) It requires considerable skill in making accurate weighings with a delicate balance; also in adjusting the current values used to the area of the electrodes, since otherwise the amount of decomposition is irregular and unreliable.

THE VIENNA SHUNT METHOD.

This is an indirect method in which the current is obtained by measuring the electromotive force produced at the terminals of a suitable shunt by its steady flow. The shunt resistance must, of course, be known.

Disadvantages:—(a) The electromotive forces to be thus measured are usually quite small and must be measured by a very sensitive galvanometer. This galvanometer must itself be calibrated, a work requiring considerable time and skill. This calibration, once obtained, cannot be depended upon from day to day owing to the fact that the slightest change in level in the instrument, irregular loss of magetism in the needle, if a Thomson galvanometer, or of torsional rigidity in the suspension, if a D'Arsonval galvanometer, will alter it. In a Thomson galvanometer the indications are greatly thrown out by even very small changes in the local magnetic field such as may be produced by keys or a knife upon the person, or active circuits even when some considerable distance away.

(b) Great mechanical stability is usually required in order that observations of the reflected beam of light may be possible.

(c) Thermal electromotive forces are met with which are tedious to eliminate or allow for.

AN IMPROVED DIRECT READING POTENTIOMETER.

This instrument, invented by the writer and illustrated in Fig. 5, is capable of being used for measurements of

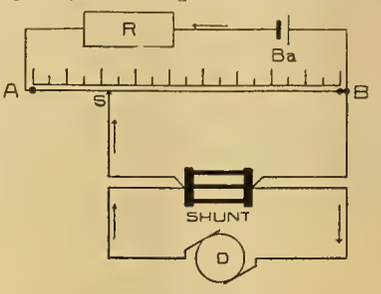


FIG. 4. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

voltage from 0 up to 1,500 volts and of current from 0 up to any required upper limit with a maximum error of not over 1-10 per cent. It is based upon the form of potentiometer originally suggested by Dr. Fleming, which is shown in diagram in Fig. 3. Some good suggestions were also obtained from the improved form of Mr. Crompton.[1]

A diagram of the arrangement of circuits in my improved form of apparatus is shown in Fig. 5. The wire $A\ B$ of Fig. 3 is here equivalented by three sets of coils marked respectively Q, M and S. The regulating resistance (R of Fig. 3) is made up of two parts, one resistance, R_Q, consisting of coils, and the other, R_Q, being made up of a bare wire of resistance equal to one of the coils of R_Q. This wire is laid back and forth upon about 350° of an ebonite cylinder and has a fixed brush, P, so arranged with reference to it that P short-circuits more or less all of the V's simultaneously, thus giving a large range of variation for a very small angle of rotation. The quick and rough regulation is effected by R_Q, while the finer adjustment is obtained by R_s[2]. The two series of coils, M and S, have at their centers two switches which are in series with the galvanometer and unknown electromotive force; moving these switches over the coils is exactly the same as shifting the points S and B of the derived circuit in Fig. 3. M is the medium movement, each coil being $1\frac{1}{10}$ of the entire resistance between A and B, while S is the very slow movement, each of the nine coils in S being equal to $\frac{1}{10}$ of the resistance of one of the coils of M. In order to get a rate of separation of the two derived circuit terminals by steps of 10 times the value of a coil of M, a third series of resistances, Q, is provided. This is a rather peculiarly arranged affair, its function being to take out resistance from between the derived circuit terminals and place it outside, or *vice versa*, the total resistance between A and B remaining always constant. The construction of this arrangement is shown in Fig. 8; here merely the diagram of circuits can be depicted. It is evident that this change of resistance from one part of the circuit to the other accomplishes exactly the same result as is obtained by M and S, viz., the separation or bringing together of the two derived circuit terminals. We have, therefore, the entire resistance, $A\ B$, divided into 1,500 parts, and the derived circuit terminals separable along this resistance by steps of 100 parts, using Q; ten parts, using M; and single parts, using S. This

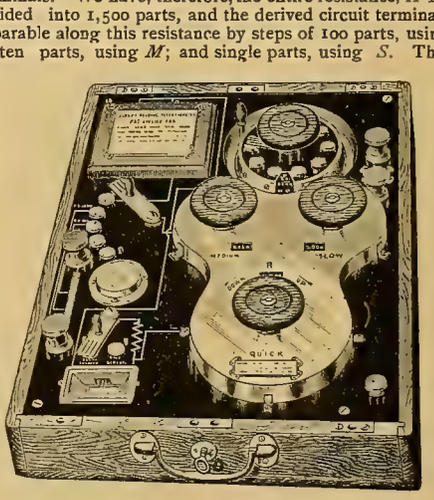


FIG 5. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

means an ability to set to 1 part in 1,500 or to 1-15 per cent.

In order to make the measurement of any unknown potential convenient and quick, a suitable arrangement of switches is provided. In the lower part of the diagram, R is a high resistance connected between two points F and G. To F is permanently joined one derived circuit terminal. The other derived terminal passes, by way of a key, K', through a galvanometer and thence to a switch, W, which plays over

1. The galvanometer, in both Figs. 2 and 4 has inadvertently been omitted; it should, in both instances, be placed in the "derived" circuit similarly to Fig. 1.

2. See "Short Lectures to Electrical Artisans," by J. A. Fleming, also "Electrical Measuring Instruments," by Jas. Swinburne, Proc. Institution of Civil Engineers, Vol. CX., Session 1891-92, Part IV.

1. See *Electrician* (London), May 12, 1893, p. 32.

2. Instead of this form of regulator I have thought of substituting some form of carbon or graphite resistance, since all that is needed is invariability for a certain period.

a number of contact points connected as shown. The two points, *S. C.*—1 and *S. C.*—2 are joined each to a terminal of a Carhart one-volt cell, the other terminals of which are joined in common to G[1]. The remaining points are connected to points along F G, dividing the whole resistance in the ratio $\frac{1}{1000}$, $\frac{1}{100}$, $\frac{1}{10}$ and $\frac{1}{1}$. In this way, with W on one or the other of the standard cell contacts, we may by proper setting of Q, M and S, and adjustment of the regulators R_S and R_Q get the electro-

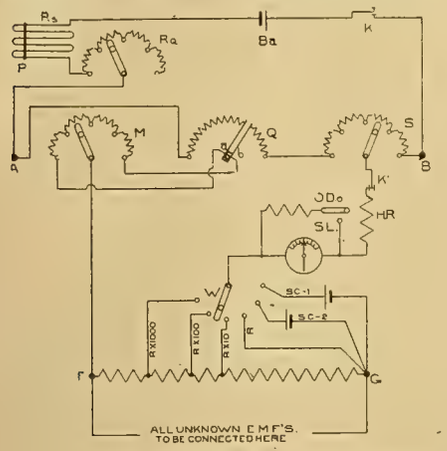


FIG. 6. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

motive force between A and B accurately 1.5 volts; we may, also, compare the two cells with one another, and thus detect any possible variations in either, as the probability that both would change alike, in the event of any change taking place, is extremely small. By now setting W on R any unknown electromotive force joined to F and G and less than 1.5 volts immediately becomes measurable. Should the electromotive force be greater than 1.5 volts and less than 15 volts, W is set on $R \times 10$ instead of on R; greater than 15 and less than 150 volts on $R \times 100$; greater than 150 and less than 1,500 volts on $R \times 1{,}000$. When measuring current leads are brought to F and G from the shunt terminals and the electromotive force measured like any other unknown electromotive force. In order to avoid the risk of accidentally getting too strong a current through either of the standard cells a high resistance, H, R, of about 10,000 ohms is permanently placed in the galvanometer circuit. A shunt is also placed around the galvanometer which may be thrown in or not, as desired, by means of the little switch placed for the purpose.

Some of the details of construction employed in this instrument are it is believed, sufficiently interesting to be worthy of description. Fig. 7 shows a novel way of economizing space and material in the construction of the coils and contact points suggested by H. L. Sayen. The contacts instead of being brass rod or portions of rod, as usual, are tubes having a metal end. Into these tubes the coil, wound on a slim spool as usual, is slipped, one end of the wire being soldered to the open end of the tube. Holes just large enough to receive these tubes are then drilled into the rubber top of the instrument and the tubes slipped up from below with closed ends uppermost until stopped by a flange which has previously been soldered around the tube at about ¾ inch from its end. A rubber plate, P, about ⅛ inch thick and also drilled through with holes corresponding to the tubes, is slipped over them from below and screwed fast to the under portion of the top plate. All the tubes are thus firmly clamped in place by means of their flanges. The other ends of each coil are then soldered to the next tube, etc.

Fig. 8 shows the construction of the resistance exchanging arrangement, M. There are two concentric circles of segments as pictured, these segments being

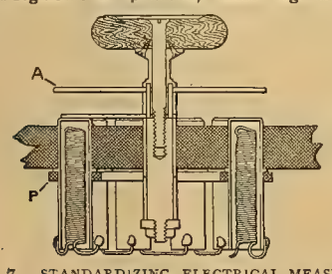


FIG. 7. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

provided with spring pieces. The coils are joined between diagonal segments. Pivoted at their center is a switch formed of a circlar plate of hard rubber, carrying at its periphery a number of angled brass wedges or knives corresponding to the segments of the coils. Instead of one of these wedges is a pair of contact pieces corresponding to A and B of Fig. 6, and joined to the rest of the circuit as shown in that figure; each piece of this pair makes contact with but one segment. It is obvious, therefore, that as the switch rotates the series is always broken between A and B, while the continuity of all the rest of the series is maintained by the wedges which pass between the segments and keep them metallically joined.

In order to get at the standard cells in case either or both of them should show any signs of giving out, all that is necessary is to remove the four screws in the raised block seen in the upper left-hand corner of Fig. 5. This will expose the binding posts to which the cell terminals are joined, the cells themselves being contained in two brass tubes passing down through the top. The binding screws are loosened and the cell or cells drawn out, when they can be shipped back to the maker for exchange.

This form of potentometer is practically direct reading, the required values of electromotive force being numerically set down upon the face of the instrument when balance is attained. The manner in which this is effected is very readily seen from inspection of Fig. 9 which shows a composite view of one of the switch devices M or S. Fixed to the switch handle so as to rotate with it and above the contact and contactor itself is a disk, A of Fig. 7, of hard rubber; this has engraved upon its upper surface a series of numbers corresponding to the coils of the series, and differing in value by an amount equal to the value of the resistance of each coil in terms of the whole resistance between A and B. Thus the disk of Q having fourteen resistances, each 1-14 of the whole resistance is engraved with the series of numbers 0.100, 0.200, 0.300, etc., up through 1.400. S, on the other hand, is engraved 0.001, 0.002, 0.003, etc., through 0.009. M in the same way has its disk, which is engraved 0.010, 0.020, 0.030, etc. In the instrument these three switch devices are grouped together as shown in the general view and in plan in Fig. 10. A raised metal box, in shape something like a three-leaf clover, covers their operative portions. In each box there is cut a rectangular hole just large enough to expose a single one of the numbers engraved upon the rubber disk below. These numbers are so placed upon the disk that the one visible indicates the number of parts of the whole resistance, which by virtue of the position of its switch are placed between the points of the derived circuit. The sum of the three numbers displayed is, therefore, the total number of parts of the whole placed between the derived circuit terminals by virtue of the position of all the switches, the number of tenths being taken from one, of hundredths from another, and of thousandths from the third.

In practice the operation of the instrument is exceedingly convenient and speedy. It is first turned to $\frac{S.\ C.}{1.}$ and Q, M and S turned until they read 1.000, since the Carhart one-volt cell gives exactly one

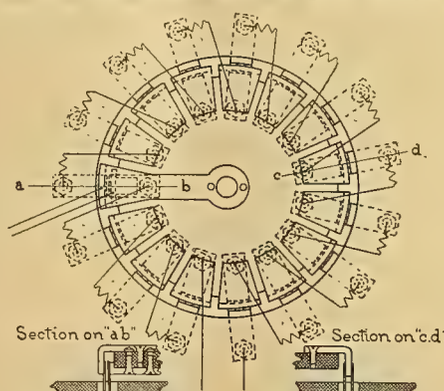


FIG. 8. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

volt electromotive force. The galvanometer switch being turned to "Galv. shunted," K and K' should be depressed for an instant. (In the instrument a single ivory button projecting up through the top operates a double contact below.) If the index swings to "R High" the two regulators, R_S and R_Q should be turned "up," as shown by the arrow engraved upon them; if to "R Low," then the regulators should go down. The key being thus alternately depressed, and the regulators altered, when balance is finally approached the shunt may be removed from the galvanometer by throwing the switch to "Galv. Direct," which will make the adjustment more sensitive, and the process continued until balance is perfectly attained. This having been done, we know that the points A and B differ in electromotive force by exactly 1.5 volts. To assure ourselves of this we may turn W to $\frac{S.\ C.}{2}$ and again depress the key; this should also give a balance. To measure, now, any unknown electromotive force, it is joined to the terminals F and G; the switch W shall be turned to R, $R \times 10$, $R \times 100$ or $R \times 1{,}000$, according as we believe the electromotive force to be between 0—1.5, 1.5—15, 15—150, or 150—1,500 volts. If we have no idea what the electromotive force is, as is very rarely the case, then we may try the points successively. Shunt the galvanometer and depress the key; if needle swings to "R High" turn Q M and S "Down," as shown by the engraved arrow until the needle swings to "R Low." If the needle cannot be reversed with W on this point try the next one, and so on until finally, if the electromotive force does not exceed 1,500 volts, reversal can be accomplished; then remove the shunt from the galvanometer and balance as accurately as possible. This done, the reading of the dials, R, multiplied by 1, 10, 100 or 1,000, according to which of the points W is on will be the desired electromotive force. If current is being measured proceed in the same way, only multiplying the electromotive force thus obtained by the resistance of the shunt in order to get the current itself. The accuracy of the work may be checked at any time by throwing W back on one of the standard cells and Q, M and S back to 1,000; perfect balance will usually persist, provided the main battery, B_a, has any charge worth speaking of.

In order to guard against any possible change in the electromotive force between A and B, during a series of measurements, due to change in the battery, B_a, the latter should be of good size, say with a discharge of four or five amperes at any rate. The resistance between A and B is 120 ohms, being always constant; this means a current of about $\frac{1}{1000}$ amperes through A B, while the key is closed; as the key is only closed for an instant at a time, this drain cannot affect even to the most infinitesimal extent the electromotive force between A and B.

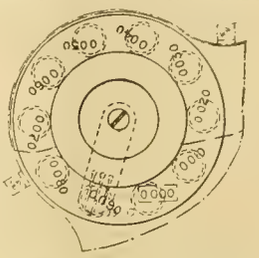


FIG. 9. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

It may seem as if the large number of rubbing contacts necessitated by this device, 14 in all, was a feature liable to introduce considerable error into the result. This is, however, not the case, for assuming the largest possible variation in each contact resistance to be 0.001 ohm (the writer has never found it larger than this in switches of ordinarily decent mechanical construction) we have, as the maximum total variation in Q, 0.014 ohm. The total resistance of A B being 120 ohms, this is seen to be less than 2 parts in 12,000 or but a little over .01 per cent.

In connection with this it is interesting to note that in adjusting the resistances of the coils Q, M and S the maximum allowable error of adjustment is a constant percentage of the total resistance A B, rather than of the individual coils. Hence if the 8 ohm coils of Q are adjusted to $\frac{1}{25}$ per cent., comparatively easy for coils of so high value, the 0.8 ohm coils of M need only be adjusted to $\frac{10}{25}=\frac{4}{10}$ per cent. and the 0.08 ohm coils of S to 4 per cent., to secure the same accuracy as regards the total of A B, *i. e.*, as regards result. The low resistances, therefore, are no more difficult of adjustment than those of the highest value, if indeed they are not easier, so that the resistances as a whole are easily brought within the required limit of not over $\frac{1}{15}$ per cent. error in result.

The value of this instrument as a convenient and quick way of obtaining absolutely reliable determinations of current and electromotive force is, we believe, very great. Other forms of apparatus more free from variable elements, as *e. g.*, tangent galvanometers are easily affected by strong fields and mechanical disturbances and require either to be always kept set up absolutely undisturbed or else to have considerable time spent upon them each time before using, in order to adjust them into good condition. In the potentiometer there are practically no variable elements, at least within limits practically infinitesmal in practical measurements. Dependence is placed solely and entirely upon standard resistances and standard cells, both of which have been thoroughly investigated by many workers and the variations of which are well understood. The apparatus is simple and compact and its mode of use can

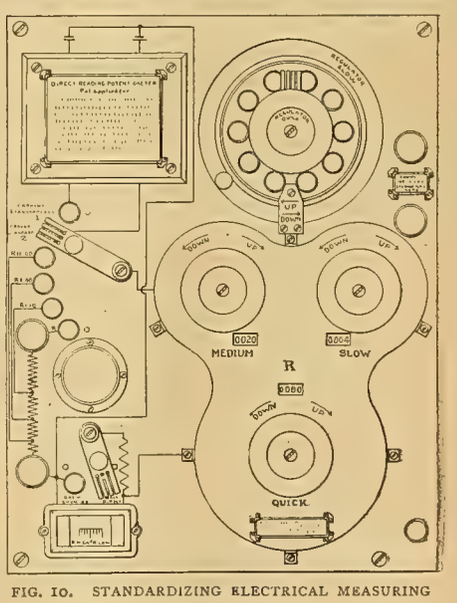


FIG. 10. STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.

be successfully learned by a schoolboy in a few moments. Being a zero method it is absolutely unaffected by neighboring currents or magnetic fields, and the galvanometer being a dead beat and jewel suspended D'Arsonval, may be used under the most severe conditions of mechanical shock and vibration. On board ship it is believed absolutely the only apparatus which could possibly be used.

1. "A One-volt Standard Cell," by Henry S. Carhart. Am. Jour. of Science, Vol. XLVI., July, 1893.

1. The dimensions over all are 11 inches by 14 inches by 5 inches deep; weight less than 10 pounds.

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THERE have been many attempts to utilize electric lighting in outdoor athletic and sporting events, but with little success. There have been base ball games and horse racing, but even the novelty of the affair has not served to stimulate lasting interest in these contests. The latest enterprise of this kind is the bicycle racing at Manhattan Field, New York, which is announced for the season beginning June 27th and lasting until September. The enterprise, it is said, has received encouragement from the League of American Wheelmen, and many noted riders have expressed a desire to give the experiment a fair trial. Wheelmen are an enthusiastic class, and if there be any merit in the project there is no doubt that they will discover it. All the conditions are said to be favorable and the track is pronounced one of the best in the country.

ACCORDING to reports from Paris, M. Bertillon, head of the police department of that city, and the inventor of the anthropometrical system which is in use in the department, is endeavoring to revive the use of the Pan telegraph, an apparatus for the transmission of portraits and sketches by telegraph. Experiments were made with this apparatus twenty years ago, and in 1877 the idea was abandoned. Sketches could be forwarded by the telautograph if the police department of every large city had an artist in its service. M. Bertillon considers that some system serving this purpose should be devised, as it would be of the greatest use, in view of the fact that portraits of suspected anarchists or of criminals are constantly being forwarded by the police of one country to another.

IT has been suggested that if Senator Gray's committee would summon the young woman who has charge of the long-distance telephone at the United States Senate, over which it is understood many of the senators' orders have been sent to Wall street, it would probably get more important information on the point of stock speculation than from all the 85 senators combined. The committee has no right to compel any person to give such testimony when there are other means of accomplishing the same result, and it would be exceedingly bad policy to submit to such measures. There is not a particle of doubt that the telephone company would resist any attempt to force its employes to divulge any information concerning business transacted over the company's lines. There is no occasion for such proceedings, and the Senate would find it just as difficult to enforce such an order as it did to compel newspaper correspondents to disclose their sources of information. However, it is not to be wondered that the committee should welcome testimony from others than the senators themselves, considering the developments of the inquiry up to date.

A NEW YORK physician, Dr. Walter T. Scheele, claims to have discovered evidence of bacteria on the transmitters of public telephones. He has examined a large number of telephones with the microscope, and as a result of his investigation he asserts that persons using telephones which are open to the public are as liable to contract contagious diseases therefrom as if they came in contact with human beings suffering from such illness. Though not discovering any germs of contagious diseases, he found in many cases acetic acid bacteria and lactic acid bacteria, the first resulting from the oxidation of alcohol and the other from the decomposition of milk. Particles of food in a state of decomposition were also brought to light by the microscope. He affirms that a person who comes from a sick room may easily breathe into a telephone bacteria which will there find every condition favorable for their development and maintenance; and he suggests that all telephone transmitters be cleansed at least once a year with a solution of alcohol, ether and glycerine, an atomizer being used for the purpose.

ELECTRICAL power transmission for factories offers one of the most promising fields for the expansion of electrical industry in the whole range of electrical applications. The advantage and economy of the system are so obvious that manufacturers need only to be convinced of its thorough reliability in large establishments to substitute it for the cumbersome and power-consuming mechanical methods of transmission or for the expensive alternative of a number of scattered steam plants. Greater economy of operation and pronounced convenience of regulation and manipulation are the obvious advantages of transmitting the power for a factory from a central plant to scattered motors, and it only remained to demonstrate to cautious manufacturers that the electrical apparatus could be thoroughly depended upon. The World's Fair did much in this direction, and every important factory operated by electrically transmitted power is a voiceless missionary. It is very gratifying, therefore, that Chicago has on its border such a large and important plant as that described and illustrated in this issue. There are other large plants of similar character here, but none of equal size in which such an absolute reliance is placed on the electric system. In this plant over 500 horse power in motors of various sizes is scattered throughout the various buildings, operating the diversified machinery of the factory, and all depending for current on one large generator. This shows the confidence reposed in electrical machinery, and the example cannot fail to be of the utmost value.

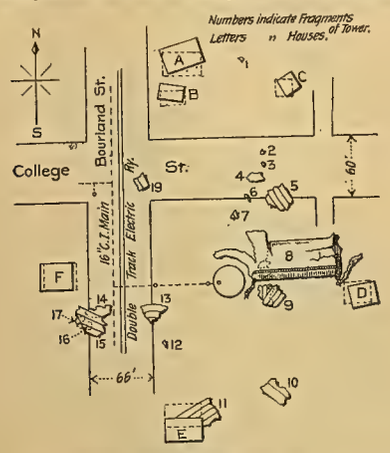
IN the United States Circuit Court at Boston last week the case of the United States against the American Bell Telephone company to annul the Berliner patent was taken up, and it is promised that it will be pushed to a speedy conclusion. This is the action begun under the last administration for the purpose of breaking down the monopoly enjoyed by the Bell company. It will be remembered that the claims upon which the government based its petition were fraud and violation of the rules of practice of the Patent Office in securing the Berliner patent. The details of the case are familiar to the readers of the WESTERN ELECTRICIAN, as a complete review of the claims upon which the action was begun was presented at the time the suit was instituted. It is to be hoped that the present case will be disposed of within a reasonable time, although the history of telephone litigation does not warrant the prediction that this will be done. The first suit which the government instituted against the Bell company to annul the original Bell patent has now been in court seven years and is still dragging along, although the patent which the action was brought to annul has already expired. There is no doubt that the proceedings were unnecessarily delayed by the Bell company, and the government claims that the same policy was adopted in the Patent Office proceedings to retard the Berliner patent until the company was ready to take it out. If the government claims can be substantiated, the Berliner patent should be repealed at once. The integrity of the patent system demands prompt and decisive action.

THOSE who advocated the adoption of the electrical execution law in New York expressed the belief that as soon as the new method was given a fair trial opposition would be withdrawn. That these expectations have not been realized is shown by the fact that there has been a very urgent demand for the repeal of the law, and the constitutional convention now in session has been petitioned to abolish capital punishment entirely and in any event to discard the present method. Those who look with disfavor upon the present law call attention to the report recently made by M. d'Arsonval to the French Academy of Sciences on this subject, in which he says: "Electric currents, as is now well known, produce death in two ways, first by lesion or destruction of the tissues, and secondly by the excitation of the nerve centers, producing a stoppage of respiration and syncope, but without material lesions. In the first case death is final, and in the second it is only apparent, and the subject may be brought back to life by means of artificial respiration. It is precisely for this reason that the American system of electrocuting criminals is extremely uncertain, because the alternating currents usually employed in these executions almost always produce this second condition of apparent death. An accident which recently occurred at Saint Denis verifies this fact under the best possible conditions, proving conclusively that electric currents cannot be relied upon to produce death with certainty. A workman accidentally received during several minutes the full force of a current of four thousand five hundred volts. Just three-quarters of an hour after he received this shock he was brought back to life by the aid of artificial respiration and the process of regular traction of the tongue advised by Dr. Laborde." These and similar reports have encouraged the opponents of the law to persist in their demand that the system be abandoned.

COMPLAINT has been made that the trolley cars of Brooklyn have been operated for some time at a dangerously high rate of speed, and residents of Seventh avenue alleged that many of the accidents that have attracted so much attention were due to the fact that motormen allowed their cars to attain such a high rate of speed as to be practically beyond their control. Mayor Schieren became interested in the matter and ordered an official inquiry. The report of this investigation has just been completed, and if it be correct there is no doubt that in some instances, at least, the city ordinances have been disregarded. Commissioner Plympton says that actual measurements of the speed maintained on Seventh avenue disclosed the fact that the cars at some points on that route were operated at a speed of from 12 to 16 miles per hour. On De Kalb avenue it was also claimed that cars were operated at from 13 to 15 miles per hour. It should be explained that these were exceptional cases, and that a large majority of the trolley cars (ten out of fourteen) did not exceed the prescribed limits of velocity. Furthermore, in the cases reported dangerously high speed was not maintained except for comparatively short distances. This would indicate that the fault rested with the motormen, and it is quite probable that further investigation will show this to be the case. When ten out of fourteen cars upon which measurements were made are operated within the limit of speed named in the city ordinance, it is safe to assume that the violations reported are without the approval or knowledge of the company, but it remains for the management to enforce the rule strictly if it desires to be free from further responsibility. There is no doubt that much harm has been done by the reports of the accidents on trolley lines in Brooklyn, and that there has been created a prejudice against the system in other places on account of the exaggerated accounts of these accidents that have been sent out. It is due to the community and to the electric railway interests of the country that every precaution be taken by the Brooklyn companies and every other operating company, for that matter, to avoid such complications as those growing out of this violation of the law.

Peoria Standpipe Failure.

A fact significant of the prevailing tendency to carefully scrutinize the possibility of electrolysis, due to the ground returns of electric railway circuits, contributing to every failure of water pipes is brought out by the collapse of the standpipe at Peoria, Ill., on March 30th. This pipe was 120 feet high and 25 feet in diameter, built of steel and wrought iron. The accompanying diagram, reproduced from the *Engineering News*, shows the location of the pipe in relation to a double-track electric railway and also the position of the various portions of the wrecked



PEORIA STANDPIPE FAILURE.

pipe and the original and present location of the damaged buildings, the fragments of pipe being indicated by numerals and the buildings by letters. It is not charged that the failure of this pipe was due to electrolysis, but the engineers who are investigating the matter appear to entertain the opinion that electrolytic action may possibly be taken into account. Dabney Maury, Jr., superintendent of the Peoria Water company, makes this statement:

It may be interesting to note that the inner surface of the sheets shows a peculiar corrosion similar to that which has often been observed here in the cast iron and wrought iron water pipes, which it has been necessary to remove or repair on account of electrolysis. This corrosion takes the form of blisters or excrescences, generally elongated and globular in shape, with the longer axis vertical. These blisters are composed of a skin of brown oxide overlying what appears to be a thin coating of black oxide. Under this second coating the surface is pitted, often to a depth of one-eighth inch. The surface at the pits, when the oxide is removed, shows a clean metallic appearance. The inside of the 16 inch cast iron inlet pipe, which was not painted or coated, shows similar but larger blisters and pits. The blisters and pits appear to increase in number and size from the top toward the bottom of the standpipe, the small pits near the top, however, being almost as deep as the larger ones lower down.

The inner surface of the upper course of sheets, which is seldom wet, shows very little oxidation, and none of this character. The two next courses, which are alternately wet and dry, show this corrosion to a limited extent. The 16 inch branch feeding the tower is crossed by a double-track electric railway, which runs along the main for nearly a mile from the tower. All the principal mains of the system are paralleled or crossed by double-track electric railways. The same corrosion is observed in the tower on the east bluff.

The daily papers of Peoria have indulged in much loose accusation on this subject, creating the impression that the failure of the standpipe was directly traceable to the ground

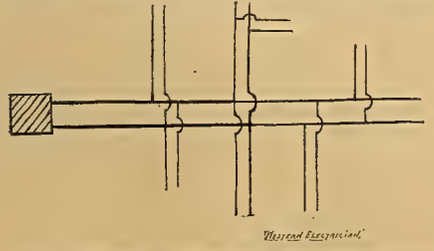


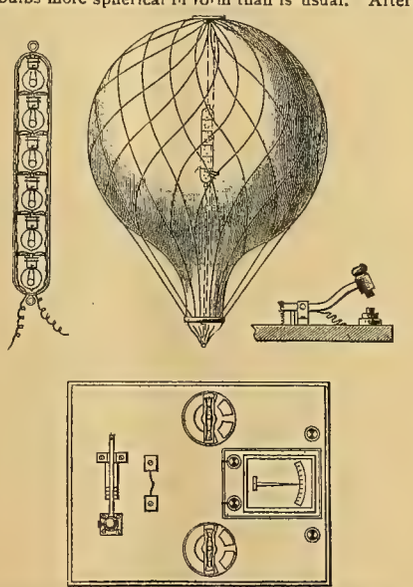
FIG. 3. STREET LIGHTING BY ALTERNATING ARCS.

currents of the electric railway system. F. W. Horne of Chicago is president of the Fort Clark Street Railway company, one of the two electric railway companies doing business in Peoria, and he has expressed a willingness to co-operate in an honest investigation of the question, undertaken by an electrical engineer competent to pass upon the question of electrolysis. Mr. Horne is of the opinion that it is extremely unlikely that the pits on the interior of the standpipe were due to electrical action; but he, like all other electric railway men, realizes the importance of the problem, and will welcome a practical solution.

An electric road from Chestertown, Md., to Rock Hall is being considered.

Balloon Signalling by Incandescent Lamps.

A device for military signalling consisting of a row of six incandescent lamps in a gas balloon having a translucent covering is shown by the accompanying illustrations. It is the work of an English inventor, Eric Stuart Bruce, who has devoted much attention to the subject, and it is said that his apparatus has been adopted by the British and some other governments. The method consists in suspending a number of incandescent electric lamps inside a captive balloon of comparatively small size, having a semi-transparent envelope, the current being supplied from any available source on the ground. A key, somewhat similar to the Morse key used for telegraphic purposes, is placed in the circuit, so that make and break can take place quickly and easily. In Mr. Bruce's earlier efforts in this direction a key was used having sliding brass contacts faced with platinum; but it was found that with this form of key the signalling could not be carried on with as great facility as was desired. Some difficulty was also experienced in procuring lamps with carbons sufficiently fine to prevent the after-glow interfering with the distinctness of the several flashes. Considerable improvement in the whole apparatus has since been made, and the balloon shown in the cut has recently been supplied by the inventor to Siemens Brothers for the Italian government. The balloon is made of cambric, this forming an envelope which is perfectly translucent. It has a diameter of 18 feet and a gas capacity of about 3 200 cubic feet. The lampholder is made in the shape of a ladder, so as to admit of its easy introduction into the narrow mouth of the balloon, and contains six incandescent lamps. These signaling lamps are of 16 candle power, rated at 55 volts, and are especially constructed for the purpose, the carbons being finer and the bulbs more spherical in form than is usual. After the



BALLOON SIGNALLING BY INCANDESCENT LAMPS.

balloon is inflated this lampholder is drawn up into its center by a cord passing through a small pulley block secured to the valve seating on the top of the balloon, and the current is supplied through insulated cables from secondary batteries, or if these are found to be too heavy for transport, or are not available, a small dynamo is used, which, in the event of no other power being at hand, may be driven by manual labor. The keyboard, which is under the control of an operator on the ground, is fitted with the Bruce signalling key, the contact pieces being short thick carbon rods fastened into brass sockets by set screws so as to be removable, being thus easily and cheaply renewed when worn away by sparking. It also contains an ammeter, a switch to turn on the current to the lamps, either through the key for flashing signals or directly for continuous illumination, an ammeter switch and a safety cut-out. Mr. Bruce states that, with this apparatus, when a trial was made from the grounds of the Albert Palace, Battersea, the signals were discernible at Uxbridge, a distance of over sixteen miles. The cuts are reproduced from the London *Electrical Review*.

It is likely that a new street railway will be started at Hammond Ind., soon. One of the projectors of the enterprise is said to be Thomas Burnham of Chicago, who owns large tracks of land in West Hammond and Burnham. The line will be started from the Indiana–Illinois state line, will run through West Hammond and Burnham, and will make connection with the Calumet electric railway at One Hundred and Fifth or Ninety-fourth streets. By this route the trip to the heart of Chicago can be made in an hour.

Street Lighting by Alternating Arcs.[1]

By Charles G. Armstrong.

There are many places, even in districts for which incandescent lighting meets the general need, where a few arc lamps can be used to good advantage, so it was to be expected that alternating plants would find some calls for arc lamps to be used on their circuits. But there has been such an amount of work done in developing alternating arc lamps—no less than fourteen having appeared on the market since last June—that there must be a larger field for these lamps than that of mere incidental adjuncts to an incandescent plant. So far, these lamps have only been used in small numbers here and there when no series arc circuits were at hand, and the common impression seems to be that this is their limit of usefulness. But I cannot agree with this. I believe that with all its faults and drawbacks the alternating arc lamp has some very good

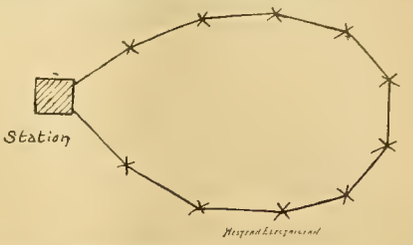


FIG. 1. STREET LIGHTING BY ALTERNATING ARCS.

points of merit, and that when these are coupled with the advantages of alternating current distribution for long distances, the alternating arc will lend itself to the conditions of modern practice about as readily as the commonly used series arc lamp. Indeed, I believe it perfectly feasible to use alternating arcs for extended street lighting with as good results as would be expected from a series arc plant under the same local conditions.

At first thought, the planning of a street lighting system for a city, and of using multiple instead of series wiring, may seem expensive; but let us look at both sides. If we plat the ideal town plant we find the lamps all arranged along a circle or loop about as shown in Fig. 1, and no doubt the series arc system with a single wire is then the simplest and cheapest. But in practice we find that the towns are not often laid out to suit such simple wiring plans, while Councilmen Smith and Jones and Brown all have their notions as to the location of the lamps, so the actual diagram is more like Fig. 2, much of the wiring being in loops so as to nearly double the length of the circuit. Of course every foot of this wire has to carry the full current (say ten amperes), whereas in multiple system, like that shown by Fig. 3, the size of the wire would diminish as we get farther from the station, both systems using about the same voltage, 2,000. This difference in the cost of the wire may amount to considerable. In the case of a 60-light town plant, for which I recently made the estimates, the alternating current transformer system showed a saving of ten per cent. on the wire over that which would have been needed for the same lamps on the ordinary series circuit.

As to the arc lamps themselves, there has been quite a change during the past year in the voltage adopted for them. The early forms were adapted to be run from 50 volt transformers with a resistance in series. Then this resistance was gradually reduced so as to run three lamps in series on a 100 volt circuit, thus giving better results and taking less energy. Lately the manufacturers have gone a step farther by planning their lamps to work direct from 30 volt transformers, leaving out all resistance. The lamps themselves are as economical as the series lamps, each consuming about 450 watts for a nominal 2,000 candle power. Of course there is the extra cost of the transformer, but this, together with the alternating arc lamp itself, costs no more to day than a first-class series lamp. The loss in the transformer does not count for much, as the transformer is always worked at full load and therefore at its greatest efficiency. What is more, the

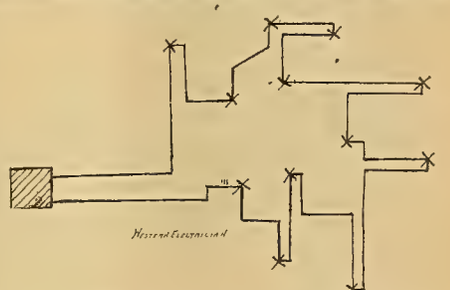


FIG. 2. STREET LIGHTING BY ALTERNATING ARCS.

transformer tends to steady the fluctuations in voltage at the lamp, so that this cannot creep up to 50 or 57 volts as it often does with series lamps.

One of the advantages gained by running arc lamps in multiple is that every lamp is independent of the rest. If a lamp should get out of order, it would keep its crankiness to itself without affecting all of the others. Indeed, the most that it could do would be to short-circuit itself and blow the fuse of the transformer. The same advantage is found in case of a break on the line, as this only cuts out the lamps beyond the break, instead of crippling the whole system. Likewise, only the joints between the given lamp and the dynamo interpose their effective resistance,

1. Read before the Chicago Electrical association.

while in series systems any and all bad joints affect the whole number of lamps. The voltage used at the lamps is harmless; they can be trimmed with safety at any time, and it is comparatively easy to plan the feeders for safety.

As to the illuminating power of the lamps, the direct current arcs have the advantage of throwing out most of the light-giving rays in a downward cone, whereas the alternating arc sends out a double cone of light. By using a reflector much of the upwardly projected light can be thrown downward, and in the case of street lighting a portion of the rays will be reflected from the under surface of the foliage. So I think that for the low suspension commonly used throughout the country, the alternating arc is the proper one, while for tower lighting the direct current arc would be preferable.

In comparing the energy of the two systems, the commercial efficiency of the dynamos and the cost of armature repairs will also be an important item. Good series generators show an efficiency of from 80 per cent. to 85 per cent. when built, but after a few years this falls to 70 per cent. and often as low as 50 per cent. On the other hand we can count on from 85 per cent. to 90 per cent. or even 92 per cent. when using alternators and can figure on quite a saving for armature repairs. I have seen figures from 300 arc light stations which average $3 per year per arc lamp for armature repairs alone. This agrees with the commonly known fact that arc armatures are much more likely to be damaged than those of an alternator. I believe that under similar conditions an alternating armature will outlast from two to three arc armatures.

The matter of carbons for alternating arcs has been an important question, as a fine grade is needed for this work. The lamp manufacturers have wisely taken the expedient of using an inclosing globe, so as to make a carbon last 18 hours which otherwise would be consumed in 14 hours. Moreover, the carbon manufacturers in this country are hastening to bring out a grade of carbons suited for alternating current work, and the probability is that we can soon purchase American carbons for these lamps at prices not much in advance of that charged for hard series arc carbons.

I have already spoken of the greater efficiency which we can readily expect from the alternating generators. We can also get them in larger sizes, so that in place of from 12 to 20 series machines, each with a capacity of eighty to one hundred lights, we would have, say, three generators of 300 to 400 horse power each, these being preferably slow speed machines, connected direct to the engines, thus doing away with belts, ropes and shafting.

At present the common voltage for the primary circuits is about 2,000, having grown to this point from 500, at which it started, and I believe we can assume from 2,000 to 2,500 volts as our settled standard. Still, if I were to plan an ideal arc lighting plant for a large city, I would choose a still higher voltage, perhaps 4,000 volts. My station would be some three or four miles out of town, and I would run my wires in conduits to some distributing centers in the city, transforming at these points to 2,000 volts, and running thence to the alternating arcs.

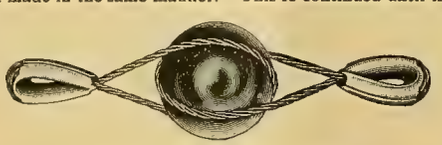
Figure out such a plant for a good sized town, and note the saving in circuits alone as compared with series circuits which have only from 50 to 100 lights each. You will then see what the prospects are for the extensive use of alternating currents in connection with street lighting by arc lamps.

Electric Coal Cutter.

The accompanying illustration shows a new and improved device for cutting coal, which has just been designed and perfected by the General Electric company. It is known as R. B. 40 and is of the rotating bar type. It consists principally of a bed frame of two steel channel bars firmly braced. Mounted upon and engaging with this bed frame is a sliding frame similarly braced consisting of two steel bars, at the rear end of which is mounted an ironclad multipolar electric motor communicating power to the feed and driving mechanism. The front end of this sliding frame carries the cutter bar, into which the cutters or bits of tool steel are held by set screws. When the cutter bar is revolved, these cutters or bits cover its entire face. The bar is driven by an endless chain, and as it is revolved is advanced by the feed mechanism into the coal or other material to be cut, to the desired depth, and the cuttings are brought out to the face of the coal by means of cleaner chains. This machine is operated by two men, one in charge of the machine and the other as a helper.

ELECTRIC COAL CUTTER.

The cutter bar, which is revolved by an endless chain, is fed forward to a depth of five or six feet, according to the size of the machine. The usual length of the cutter bar is 39 inches, but 42 or 48 inch bars can be used where the cutting is not too hard. When the full depth is reached, the feed is thrown off, and by means of a reverse lever the cutter bar is withdrawn to its starting point and automatically stopped. This completes the cut, and the machine is moved over the length of the cutter bar used and another cut made in the same manner. This is continued until the entire width of the room or entry is under-cut, after which the machine is again loaded on its carriage and taken into another room. The cuts are made in from four to six minutes. The construction of this machine is extremely simple and all parts are made in duplicate and are interchangeable.



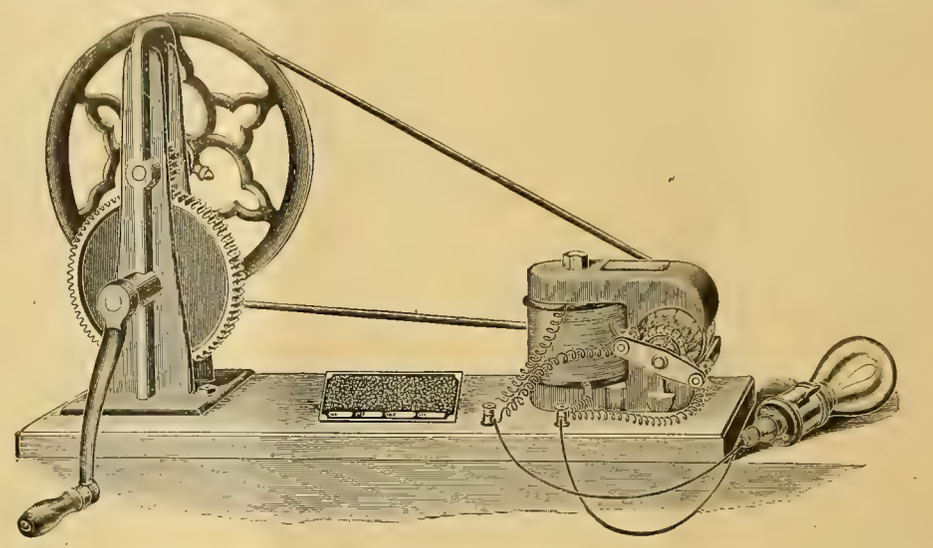
METROPOLITAN SPECIALTIES.

Metropolitan Specialties.

The insulator shown in the accompanying illustration is designed for insulating span wires on overhead construction of electrical railways, and is, as well, adapted for suspending arc lamps and similar work where high insulation, strength and durability is desired. It is also suitable for cutting in as circuit breaker on arc lines. The ball is made of the toughest green glass, three inches in diameter with two grooves running part way around the ball at right angles. To this is attached interlocking loops made of seven-strand Gale steel wire, dipped in P. & B. insulating compound, thereby insuring high insulation. At either end of the steel wire is fastened a malleable iron casting. The insulator will stand a strain of 6,000 pounds, and will withstand the extreme changes of weather without deterioration, at the same time maintaining high insulation. This insulator is a specialty of the Metropolitan Electric company, Chicago.

Model Experimental Dynamo.

An interesting piece of experimental apparatus is shown in the accompanying illustration. The machine was designed especially for the use of schools and students of electricity, and to them it is of especial value, since it gives the whole theory of the modern dynamo and follows in construction every detail found in large generators. It is made for actual use, all parts being made of the best material and in the most substantial manner. The armature core is laminated and wound with double covered wire; its shaft is made of steel and runs in brass bearings. The commutator has 16 bars, ample brush contact and will wear for years. The machine is operated by hand power. The shafts are of steel, the gears are cut from solid metal and run without noise. The pulley is turned and balanced and all parts are made with the greatest accuracy. Each dynamo, before leaving the factory, is set up and tested and made to generate, when running by hand power, 50 per cent. in excess of the rated voltage as marked on the base. The insulation of each machine is tested with an electromotive force of 120 volts. The model dynamo weighs 20 pounds, is four and one-half inches high, and nine inches in length through its armature shaft. At a speed of but 1,600 revolutions per minute it has an output of 75 watts. The entire apparatus is manufactured and placed upon the market by the Elbridge, N. Y., Electrical Manufacturing company.



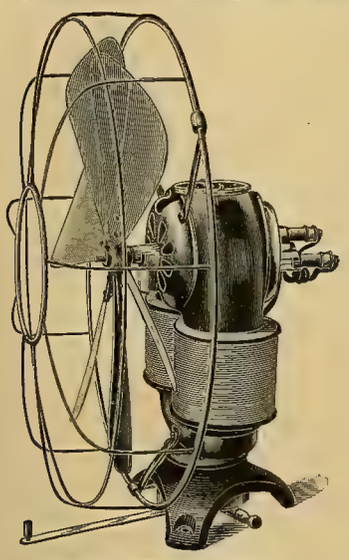
MODEL EXPERIMENTAL DYNAMO.

16,000 Light Alternator for St. Louis.

There is now in process of construction at the Schenectady works of the General Electric company an alternator of huge dimensions which is to be completed by August 15th for the Edison Illuminating company of St. Louis. The alternator is to be of 16,000 lights capacity and will be coupled direct to a Corliss Hamilton engine of 2,000 horse power capacity and will be one of the largest ever constructed. It is the first of a series to be built by the General Electric company for the St. Louis lighting company and is of the new monocycle type adopted by the company, which comprises two windings of the armature, one being the ordinary straight winding of an alternating machine, the other producing an electromotive force at an angle of 90° with that of the first winding. The advantages of this idea are greater flexibility in the system as well as a greater ease in winding. As may be judged by the output of the machine, its dimensions and weight are very great, the armature being 16 feet in diameter, the diamater of its shaft 20 inches and the weight of the armature without its shaft 75,000 pounds. When completed the armature core and coils will be tested by an alternating current of 5,000 volts. This huge alternator, which will be run at a speed of 90 revolutions a minute, making 7,200 alternations and giving an output at full load of 800 kilowatts with an electromotive force of 12,000 volts, will have 80 field poles of laminated iron and an ironclad armature. The curve of the electromotive force will be a perfect sine curve, and a type of construction will be followed which will allow the fields to slide upon rails parallel to the axis of the armature, which will make it possible for ready access to be had for making repairs.

Roth & Eck Fan Motor.

The type of the armature adopted in the fan motor shown in the accompanying illustration is a Gramme ring, proportioned with a view of maximum efficiency. The brushes themselves are small carbon pencils, fitted in adjustable holders and are self-feeding, require little attention and can be easily replaced. The commutator is made of gun metal carefully insulated with mica. The speed can be regulated by a switch giving three speeds, 800, 1,400 and 2,000 revolutions a minute. The motor is placed upon a tripod swivel base and can with little exertion be turned to face in any direction. The guard is made of heavy, stiff brass wire and is attached to the field casting in three places. In point of appearance, workmanship, durability and electrical efficiency, these motors are especially praiseworthy. The current required for an ⅛ horse power motor is equal to that for one 16 candle power lamp. The motor is manufactured and put upon the market by Roth & Eck, 30–34 Market street, Chicago.



ROTH & ECK FAN MOTOR.

Plain Milling Machine.

The plain milling machine shown in the accompanying illustration is placed upon the market by the Brown & Sharpe Manufacturing company, Providence, R. I., and is known as the company's No. 0 type. The table has an automatic longitudinal feed of 16 inches, a traverse movement of four and a half inches, and can be lowered 12 inches from center to spindle. This is one of a series of machines, so that its description is applicable in general, except as far as dimensions are concerned, to larger plain milling machines. There is also a series of Universal milling machines manufactured by this company. In those, however, the table is fed at an angle to the axis of the spindle, and there is provision for automatically cutting spirals. The plain machines are the more simple, and as the table is not swiveled it can rest directly upon the knee or other support, and the machine is stiffer and can take a heavier cut or accomplish more work in a given time. This machine has just been placed upon the market and presents a number of new features, chiefly in connection with the feed. It is made with the intention that it shall be a perfect machine of its size. The straight bearings are scraped to surface plates; the cylindrical bearings are ground and fitted to standards; the feed and elevating screws are accurately cut, and the alignments are correct. In almost every respect, by manufacturing in large numbers with expensive special tools and by enforcing a thorough system of inspection, the company has attained the greatest accuracy than can be reached in the usual methods of manufacture.

Grooved Sable Rawhide Belting.

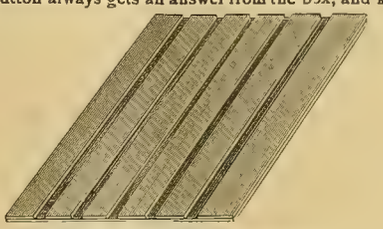
An idea may be gained from the accompanying illustration of the construction of the grooved belting placed on the market by the Shultz Belting company, St. Louis, Mo. This style of belting is made of the same material as the Shultz patent sable rawhide belting, which is known to the trade as possessing many superior qualities. The advantages of the grooved construction are apparent upon an examination of the illustration. The grooves, running lengthwise, serve the purpose of channels to permit the escape of air between belt and pulleys, and to such a degree that the air cushion is overcome, which makes it possible to run it very nearly as slack as link belting, and more so than by using punch holes, which deteriorate the belt in strength in proportion to the size and number of the perforations. Beside this, the grooves are kept constantly clean by the current of air passing through them. It is also possible to run this belt satisfactorily with either slack top or bottom, and it is practically noiseless.

New Use for Pins.

The London *Electrical Review* relates this incident: On Monday night, May 7th, there was a considerable failure of the public arc lamps (Brush system) in the western district of the city of London. In all 36 lamps failed to light up, these being the lamps on one side of New Bridge street, Ludgate Hill, Fleet street, Farrington street, etc. The cause of the failure was the short-circuiting in the Queen Victoria street subway of the conductors on the concentric main from the generating station at Banksside, and forming part of the circuit serving these lamps. This short-circuiting was caused by a pin driven into the cable through the wires of the outside conductor and reaching to the center. The pin had been inserted by one of the Electric Lighting company's employes in the subway. This man had also inserted a second pin in another concentric cable running alongside. His desire was to light a glow lamp by connecting it across the two conductors. He had probably seen the same thing done before with the low tension distributing mains. As he failed to secure this result, or, indeed, any result at all, for the mains were dead at the time, he apparently was a little frightened, and left the spot after withdrawing the pin from one of the cables. The fault was not easy to localize, and current was not sent through the lamps until close upon dawn on the 8th.

Electrical Mail Box.

Edward C. Belding of Chicago has invented a mail box so fitted with an electrical connection that when a letter-carrier raises the cover of the slot in which the letters are placed he closes the circuit and the owner of the box is told that his mail has been delivered. At the same time the carrier is assured that the person for whom the letter was intended has received notice of its delivery, as the bell in the house rings an answer. The carrier can then go without waiting for some one to come to the door. Should anyone tamper with the box or in any way succeed in opening the door the warning bell is sounded. Near the center of the box is a push button. A person pushing this button always gets an answer from the box, and knows from this that the bell on the inside of the house has been rung. At night a third wire, which is attached to the burglar-alarm system, is connected, and anyone opening a door or window not only alarms the occupant of the house but gives the police on the outside notice that something is wrong. Any attempt to break the box would have the same result, both the owner and the police being notified.



GROOVED SABLE RAWHIDE BELTING.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 18.—The last action of the old rapid transit commission was taken last week. Its members are now out of office, but at the final meeting, held on May 27th last, they instructed John M. Bowers, counsel to the commission, to apply to a judge of the Supreme Court to fix the compensation for their ineffectual efforts of the last three and one-half years. Mr. Bowers has put in his application to the General Term of the Supreme Court. The application was made on behalf of William Steinway, John H. Starin, John H. Inman, Eugene L. Bushe, Samuel Spencer and David F. Porter. The present rapid transit law provides that the supplanted commissioners shall be awarded by the Supreme Court reasonable compensation, even though they had failed to dispose of any franchise. The special committee of the new commission met last week. The purpose of the meeting was to secure a place of meeting for the commission and the nomination of a man who shall act as secretary. No decision of importance was reached.

The highway commissioners of the town of Jamaica, Queens county, having recently granted permission to the Long Island Electric Railway company to construct its proposed road, another important step has been taken to further advance the work of building several roads connecting several of the principal towns and villages on the south side of Long Island with Brooklyn. The new railroad syndicate, which is composed of Philadelphia and New York capitalists, held a secret meeting last Friday night. The Jamaica branch of the road is to run from the junction of Liberty avenue and the Queens county line to the village line of Jamaica, and beyond that point to a distance of about fourteen miles. The route, as proposed, starts from the junction given and runs thence through Henry street to Bandman avenue, to Elm street, to South street, to Merrick road, to New York avenue, to the south village line and in Washington street, Jamaica village, between South and Fulton streets. A spur of the road will be run from Jamaica to Far Rockaway, and along the shore to Rockaway. The main line of the road will run parallel with the tracks of the Long Island railroad, through the south side, passing through Springfield, Valley Stream, Rockville Center, Oceanville, Baldwins, Milburn, Freeport, Merrick, New Bridge, Seaford and on to Babylon. There will be another branch north and south from the main line from Rockville Center, tapping Hempstead village, Garden City and Mineola on one side, and East Rockaway, Barnum Postoffice and to Long Beach on the ocean side. Rights to go through to Suffolk county and eventually to reach Patchogue will also be applied for by the company in pursuit of its purpose to traverse Long Island with a system of electric lines.

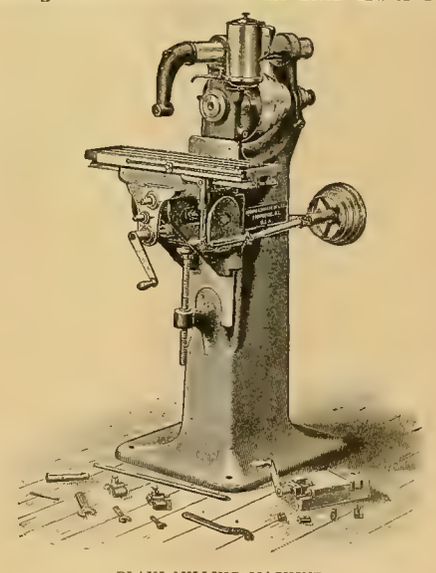
At a recent meeting of the stockholders of the United Electric Light & Power company they authorized the president and secretary of the company to execute and deliver to the Union Trust company an instrument mortgaging to the Trust company all the property, real and personal, and all the franchises, privileges and immunities of the company for $5,000,000. The money is to be used by the electric company to liquidate its floating indebtedness and to retire outstanding bonds, and also for the extension and development of the concern. Five thousand coupon bonds were issued at five per cent., aggregating $5,000,000.

The hundreds of citizens who are accustomed to making evening trips to Harlem during the summer months will have a double incentive from June 27th to the end of September. On the former date the first of a series of bicycle races and other games will be held at Manhattan Field, which has been leased for the season. Those interested in the novel enterprise have organized the Manhattan Cycling Amusement company. The primary object is to give games twice a week by electric light, and arrangements are being made for the erection of fifty arcs, which are deemed sufficient to light up the track and enclosure brilliantly.

The Atlantic avenue Railroad company has made a contract with Postmaster Sullivan in Brooklyn, for carrying the mails from the main office to the Union station at Fifth avenue and Thirty-sixth street. From this point the mail will be transferred to a special closed trolley car, painted white, and marked "U. S. Mail," for distribution along the line of the road from the station to Coney Island. The company is also considering the proposition of putting mail boxes in all the trolley cars for the convenience of the passengers. W. F. O.

St. Louis, Mo.

ST. LOUIS, June 16.—The Grand Avenue Railway company will build a double track road on Grand avenue, extending from the water tower in the north end to Prim street in the south end of the city. The company will have 10 miles of double track road. Grand avenue is the widest and most fashionable thoroughfare in the city. The new line will cross all the east and west lines in the city, and will run to Tower Grove Park, and also the Missouri Botanical Gardens, directly accessible from both ends of the town. The new line makes use of portions of tracks belonging to five of the east and west lines which already have tracks on Grand avenue. The officers of the



PLAIN MILLING MACHINE.

company are: President, James G. Butler; vice president, J. W. Buel; secretary and treasurer, E. H. Conrades; directors, G. G. Stiefel, E. C. Donk and Thomas Halpin. Winthrop Bartlet, chief engineer, is now finishing the details of the entire work and construction will begin by July 1st. The power house will be located at 3738 Manchester road, and will have switch connection with the Wabash railroad. The power plant will consist of two 250 kilowatt generators, each directly connected. The rolling stock will comprise 25 twenty-foot cars with single trucks, each truck being equipped with two 50 horse power motors.

The attitude of the city in considering the advisability of constructing and operating a conduit system of its own is causing much interest to be taken in the underground matter. The Edison Illuminating company has asked for permission to construct a conduit system covering the central part of the city. It is claiming a right to do so under a clause of its lighting contract. The matter is now in the hands of the board of public improvements.

The Western Union Telegraph company has introduced a bill before the city council providing for the construction of a conduit system for its wires in the central part of the city. As a compensation for the privilege, the bill provides that one duct in each conduit shall be set aside for the exclusive use of the city service.

The St. Louis Underground Service company has made application to the Board of Public Improvements for permission to extend its conduit system from the main office of the Postal Telegraph company on Olive street, between 4th and 5th streets, down Olive street to 3d street, and then south on 3d street to the Merchants' Exchange at the corner of 3d street and Chestnut street. This extension is to enable the Postal Telegraph company to put its wires underground.

The Forest Park, Laclede Avenue & Fourth Street division of the Missouri Railroad company is now using its new down-town loop. The loop leaves the main line on Market street at 13th street, runs north on 13th street to Olive street, then east on the Olive street cable road, which also belongs to the Missouri company, to 4th street, then south on 4th street to Chestnut street, where it connects with the main line running west. The loop passes some of the more important buildings and places of interest in the city. R. J. H.

PERSONAL.

Dr. Karl Edward Zetzsche, the noted German telegraph engineer, died in Dresden on April 18th.

At the recent commencement the degree of LL.D. was conferred on Nikola Tesla by Columbia College.

William H. McKinlock, president of the Metropolitan Electric company, Chicago, was absent from the city on a fishing trip for a few days last week.

Prof. Sidney H. Short of the Walker Manufacturing company, Cleveland, and J. M. Atkinson, general district agent for the central states for the same company, are in Chicago.

I. H. Moses of Cleveland, who is at present superintending the installation of the interior conduit system in the Garfield building, Cleveland, O., was in Chicago for a few days this week.

H. H. Hornsby, who has been connected with the electrical inspection department of Chicago for about two years in the capacity of inspector, has been appointed chief inspector. The usual number of inspectors will be retained.

R. S Brown, who, in conjunction with Speaker Crisp and Congressmen Haynes, Mutchler and Libby, is building the Freeport, Ill., electric railway, returned to his home in Eaton, Pa., last week. B. J. Arnold, Chicago, is the engineer for this road.

ELECTRIC LIGHTING.

Rankin, Ill., is to have electric lights.

The Flatbush, L. I., Gas company is installing an electric lighting plant.

The Creusot works will exhibit an alternating current street railway system at the Lyons, France, Exposition.

The electric light plant at Warren, N. Y., was destroyed by fire recently. The loss is $20,000. The gas works near by were also badly damaged.

The Illinois Valley Electric Light & Power company, Ottawa, Ill., has failed for $11,000. The company operated an extensive plant for Ottawa and Marseilles, and has been in business about five years.

Halifax is a small English town, says the Philadelphia *Daily Press*. Two or three such could be put in one of our wards; but its government knows enough to burn its refuse, which is dumped in a furnace constructed with a special draught. Three tons of the refuse equals one ton of coal, and the power generated is used to run electric lights.

The London, Brighton and South Coast Railway company is reported to have reached the conclusion that electric lighting on its trains is as satisfactory as either gas or oil. All three systems have been tried upon this line, but the fact that it is not necessary to haul the electrically lighted trains to the lighting station, as is the case with those lighted by gas, appears to tell in favor of electricity. The first cost of gas for a train of 10 carriages, including building and apparatus, is given at about $3,500 per train, oil about $600, and electric light $2,000. The expenses with maintenance with gas is about $600 per year per train, with oil from $350 to $650, and with electricity $250. The latter is the average cost obtained from a service of 30 trains.

The consummation of the purchase of the Brush lighting towers by the lighting commission will not affect the illumination of Detroit, Mich., by the Detroit Electric Light & Power company. It was understood when the deal was made for the purchase of the towers about a year ago that the company should, in consideration of the purchase, continue to light the city as long as it was desired to do so. It might have been supposed that when once the company got the money for the towers it would be in a position to go out of business at any time, and leave the city in darkness. Before the committee get the cash for the towers, however, it will give a bond to carry out its part of the contract, and it will keep on furnishing the city light until the city plant is in operation.

The electric lights in Union, Mo., were successfully started on the evening of June 6th, the event being made the occasion of a celebration. This plant, which was designed by William H. Bryan, consulting engineer of St. Louis, presents some novel features. The lights are operated from A. A. Tibbe's Westinghouse station at Washington, Mo., 10 miles distant. The alternating current used on the line between Washington and Union is 4,000 volts. At Washington a step up transformer is used, and a step-down transformer is locating at the entrance to the town of Union. The service in Union consists at present of 250 16 candle power commercial lights and five 50 and sixteen 32 candle power street lamps. It is estimated that with the average load the losses due to transformation and transmission will not exceed 5 per cent.

ELECTRIC RAILWAYS.

The Suburban Traction company proposes to equip its lines in Bloomfield, N. J., with electricity.

It is proposed to change the motive power upon the street railway in Pine Bluffs, Ark., to electricity.

A franchise has been granted the Cortland, N. Y., & Homer Horse Railroad company to change its motive power to electricity.

There is a good prospect that the proposed electric railway between Bangor, Me., and Stockton Springs will be constructed as far as Frankfort this year.

The railway at Fort Wayne, Ind., will be considerably improved this summer. It will be double tracked with T rails, and electric motive power adopted.

An effort is being made to secure an electric road between Elyria, O., and Cleveland by way of Dover and North Ridgeville. The right of way has been secured.

A petition from the Pawcatuck Valley Street Railway company has been presented to the town council of Westerly, R. I., asking permission to use the public highways for an electric railway, from the railway station to Watch Hill.

A project is on foot to construct an electric railway from Hazel Hill to Camso, N. S., a distance of three miles. There is also talk of establishing a similar line between the pump mill at Milton and Liverpool Town, a distance of six miles.

A good start has been made toward laying the foundations for the power station of the Nassau, N. Y., Electric Railway company, and the track and overhead construction are progressing rapidly. The company has already received several large shipments of trolley line insulators from the H. W. Johns Manufacturing company of New York.

The long talked of plan to construct an electric railroad between Sandlake and Albia, N. Y., is again revived, and is now in a fair way of consumation. The Troy & New England company, which holds the charter, has virtually decided to begin work soon. The plans are to run passenger and freight cars from River street in Troy to Sandlake.

For three years the street railway owners of St. Louis have been negotiating for the consolidation of all the lines. This is now about accomplished, only minor details and some changes in legislation standing in the way, which will no doubt be brought about. When the consolidation is effected 290 miles of railway, capitalized at $19,000,000, will be under one general direction. By the transfer system contemplated a passenger can reach any point in the city for one fare.

The government of Denmark has received an application for a concession for an electric railway from Klampenborg to Humlebok, a distance of about 16 miles. The line is principally intended for passenger traffic, but will also be used for the transportation of goods. It will be a private undertaking, and no assistance is being asked from the government. The government itself had proposed a railway from Klampenborg to Elsinore, which would entail an expenditure of $1,575,000, but largely on this account the parliament has thus far declined to pass the bill, and will be the more ready, therefore, to accept the alternative scheme which will give the country the transportation facilities without the expense.

The extension of the Liverpool overhead railway to the Seaforth Sands station, having been approved by the Board of Trade, was opened for public traffic April 30th. The extension is from the northern terminus at the Alexandra Docks station to the outlying northern districts along the Mersey estuary. The structure was sometime ago completed for a half-mile beyond the Alexandra Docks to the point where the repair sheds are now situated, and the new portion extends from this point for about 500 yards to the Seaforth Sands station. The extension has cost about £30,000. The total length from the Herculaneum Docks station, at the south end, to the Seaforth Sands station, at the north end, is now a little over six miles, and the total expenditure in construction and equipment has amounted to over £600,000. At present there are 14 stations in the six miles, and it is proposed to open three new stations.

TELEPHONE.

A new company was organized at Norwalk, O., June 4th, to be known as the Ohio Harrison Telephone Construction company, to control the use of the Harrison telephone in the state of Ohio. The capital of the concern has been fixed at $20,000.

Evansville, Ind., has been asked by the Vanderburg Stethophone company for a franchise allowing the company the right to put in an exchange and a system. The committee to which the application was referred has reported favorably.

At a meeting of the stockholders of the Harrison Telephone company, June 5th, contracts for construction with James E. and Robert L. McElroy were approved and the capital stock reduced from $80,000,000 to $40,000,000. Half the stock was treasury stock, and never having been issued was canceled.

The burning of the telephone exchange at Toledo, O. last month, which was attended with a loss of about $10,000, suspended the service entirely, and it will probably be some time before it is entirely renewed. The fire originated in the tower, and its origin has not been definitely determined. A great portion of the loss was due more to water than fire, the large switchboards suffering particularly in this respect.

The opening of the long-distance telephone line between Kansas City, Mo., Leavenworth and Atchison, Kan., by the Missouri & Kansas Telephone company, May 22d, was made the occasion of a celebration in Kansas City. The Commercial Club rooms were plentifully supplied with instruments, and conversation was carried on with the several points on the line. Instrumental and vocal music rendered in Kansas City was vigorously encored in Atchison and Leavenworth. Much of the success of the entertainment and opening of the line is due to Superintendent W. W. Smith of Kansas City.

Alice Lavery, formerly employed by the Chicago Telephone company, has commenced suit in the Circuit Court against the company, asking $30,000 damages for personal injuries. In July, 1892, she was sitting at her place in front of the big switchboard, when, she declares, she received a tremendous electric shock which threw her to the floor in a "spasm." A thunder storm was raging outside at the time, and owing to alleged defective lightning arresters, she tells the court, the accident occurred. Since that, the plaintiff asserts, she has been unable to attend to business, and has, in fact, become a hopeless invalid.

TELEGRAPH.

The Chicago & Northwestern Telegraph company, which is leased by the Western Union Telegraph company, last week elected the following officers and directors for the coming year: President, Thomas B. Scully; secretary, A. R. Brewer; directors, John B. Manning, Francis L. Manning and I. McMichael.

The royal commission on electrical communication with lighthouses and light-vessels, England, has made a second report. The commissioners recommend that electrical communication by aerial wires be established without delay between the telegraphic system of the country and twenty-one specific shore lighthouses and lighthouse stations.

The Western Union Telegraph company is making preparations to place all of its wires underground in Detroit, Mich. It appears that the company has no franchise for operating in Detroit, and although its wires were ordered underground the council could make no provision giving the company permission to tear up the streets. It was advised that the company should apply to the council for a franchise, and it has given notice that it will do so.

MISCELLANEOUS.

It is stated that a Swedish electrical engineer, the inventor of a process for tanning by electricity, intends to establish a large tannery at Omaha, Neb, where his process will be applied.

A novel system of branding horses, cattle and sheep is reported from Australia. The brand is kept the required heat by electricity from storage batteries. From these a flexible rubber tube carries the conductors to the brand, which is heated from within. It is claimed that this brand possesses many advantages, and that it marks without a blotch, and is kept at a uniform temperature.

T. C. Martin announces that he will soon issue a book on "Electrical Boats and Navigation," which will include primary battery boats, storage battery boats, screw and paddle-wheel boats, rowboats, gigs, pinnaces, catamarans, torpedo boats, submarine boats, dirigible torpedoes, lightships, ferry boats, etc. It will also include some chapters, by Joseph Sachs, on the operation of canal boats by electricity in a variety of ways; and there will be other

chapters on boat haulage by magnetic adhesion, etc. The book will be illustrated.

A novel claim for water has been filed by the Redlands, Cal., Electric Light & Power company. In preparing for the power for its plant, the water of Mill Creek was carried through a large pipe for a long distance, and the electric company now files a claim for 100 inches of this water, which amount, it asserts, is saved from evaporation and seepage and other waste by reason of its being conducted through the pipes of the company.

George P. Low, who was employed by the San Francisco city hall commissioners lately to report some scheme for lighting, heating and ventilating the hall, filed his report on May 31st. He finds that a permanent and independent electric plant for the hall would be the best and most economical under certain conditions. He would favor three elevators of the Sprague-Pratt multiple sheave type. He contemplates storage batteries in conjunction with the lighting and elevator service, the battery to be charged from the dynamos operating the elevators. The ventilation fan-blowers will be operated by electricity. The new boilers just put in the building are of sufficient capacity to operate the proposed plant, but two reserve boilers would also be advisable. A plant for lighting only would cost $22,550, including wiring, and it would cost about $12,757 per year to operate. The best and most satisfactory plant, providing lighting, heating and ventilation, would cost about $110,875, and its annual operating cost would be $20,501.

TRADE NEWS.

The Washington office of the General Electric company has been transferred to 227 East German street, Baltimore, Md.

George S. Searing, the Chicago representative of the Hart switches, has moved his office to 1644 Monadnock building.

George A. Mayo, consulting and constructing engineer, has opened an office at 43 Bryan block, 160 La Salle street, Chicago. Mr. Mayo makes specialties of power transmission and storage battery installations.

Henry V. Parsell has purchased a new and handsome electric launch from the General Electric Launch company for use on Schroon Lake during the coming summer. The launch is equipped with batteries of the Consolidated Electric Storage company.

The Metropolitan Electric company, Chicago, is presenting its friends with lead pencils marked "Xatric. That's the Switch." It is needless to add that it refers to Paiste's line of switches which the company handles so extensively and which has become so well known among electrical men.

The Root improved water tube steam boiler is a strictly high grade boiler, possessing thoroughly reliable, economical and efficient qualities. The Abendroth & Root Manufacturing company, 28 Cliff street, New York, N. Y., sole manufacturer, has put the Root boiler in some of the largest electric light and power stations in the United States.

The American Machinist company, Cleveland, Ohio, has issued a catalogue descriptive of its Institute for Home Study of Electricity and of the electrical apparatus furnished for its students which may be used in schools, colleges, experimental laboratories, etc. The reading matter of the book exhausts its subjects and illustrates some of the company's more important machinery.

The Wallace Electric company, Chicago, has added to its business a complete line of electrical house goods, including a number of well-known and standard specialties, and reports business as being satisfactory at 307 Dearborn street. Leland T. Milnor, formerly with the Ansonia Electric company and later with the Central Electric company, will have charge of this department.

The contract for trolley line insulators has been awarded to the H. W. Johns Manufacturing company, New York, by the Poughkeepsie, N. Y., Wappinger Falls Railway company. The Bridgeport & Conn. Traction company began last week the excavation for its power station. Poles are being located and deliveries of the trolley line insulators furnished by the H. W. Johns Manufacturing company will soon begin.

The Clonbrock Steam Boiler Works, Brooklyn, N. Y., closed the following contracts for Climax boilers last week: United Electric Light & Power company, New York, N. Y., 10,000 horse power; Thomson-Houston Electric company, New York, N. Y., 1,000 horse power; Newark Electric Light & Power company, Newark, N. J., 2,000 horse power; Central Railway & Electric company, New Britain, Conn., 1,000 horse power.

O. W. Russell has compiled another catalogue and price-list for the Link Belt Machinery company, Chicago. The book takes notice, principally, of the elevators and conveyors for handling clay, tile, bricks, cement, sewer pipe, etc., manufactured by this company. The reading matter is emphasized by a number of illustrations showing the application and construction of much of this machinery. The book presents a very neat appearance, and gives a good idea of a portion of the Link Belt company's machinery.

The Mather Electric company, Manchester, Conn., has issued a catalogue descriptive of its ring type dynamo for incandescent lighting, which has been well and favorably known for the last 10 years. It has been improved and simplified from time to time and is a well built and efficient dynamo. The company claims for the ring type dynamo that it has the least number of parts, requires little attention and care in operation, and is remarkable for its simplicity. It is constructed upon thoroughly sciencific principles and is excellent in its design. The electrical efficiency of this dynamo is exceedingly high. The electrical design lends itself very readily to superior mechanical construction, and full advantage of this fact has been taken, the result being a machine perfect in its mechanical details, giving very high commercial efficiency.

The Mica Insulator company, 218 Water street, New York, is calling attention to the many applications which micanite, one of its products, has in electrical machinery. An illustrated catalogue lately issued by the company presents in a satisfactory manner its numerous fields of usefulness. On account of its high insulating qualities micanite can be used in places where inferior insulators would not be practicable, because of the thickness they require to insulate. It does not absorb oil or moisture. Its mechanical and electrical durability is high. It is equal in efficiency to India sheet mica. It effects great saving over the use of mica when the labor entailed and waste mica are taken into consideration. It can be furnished in almost any form required. Micanite is made of pure India sheet mica, cemented together with a cement of very high resistance. The catalogue contains numerous testimonials testifying to its value.

The Royal Electric company, Peoria, Ill., has issued an illustrated catalogue of its machinery, including its direct and alternating apparatus as well as its type of transformer, which is worth reading. No effort has been made in the book to give a scientific description of the company's apparatus, the purpose being only to bring to notice some of its superior points. The Royal alternator has many advantages which are worthy of consideration, and these are brought out prominently. Illustrations of all of the company's electrical machinery are presented and form a pleasing portion of the catalogue. The transformer receives particular attention. The different parts which make up this transformer have been designed so as to reduce heating to a minimum, to make the regulation perfect, and the insulation the very best. The efficiency is the highest obtainable. Great care is taken in selecting good material only, and a rigid inspection is maintained during the entire process of manufacture. The type is neat in appearance, easy to place in position, and can be operated on all systems now in general use.

It is rarely that the details of an electric system are placed before the public in as complete and attractive a manner as those of the Standard system of dynamo-electric machinery and accessories, which have been summarized and classified in the book recently issued by the Standard Electric company, Chicago. This book is intended to give a very thorough idea of the Standard types of machines comprised in its arc, incandescent and alternating systems, as well as of the switchboard and line apparatus used in the installation of a practical system. Excellent half-tone work gives an opportunity for the display of the details of the machinery, and it may be mentioned in this connection that one of the chief points of excellence of the book is the handsome typographical appearance it presents, combined with its meritorious illustration. The Standard type of electrical machinery is too well known to be mentioned in detail here, but the work describes and illustrates each part in a thorough manner. The accessories of an electrical system of lighting are all given careful attention and may be praised for their appearance and value. The company's new line of iron poles, especially designed to meet the demand for ornamental poles adapted to either boulevard or avenue work or for general street lighting is illustrated. The poles, as designed, all have interchangeable tops, enabling a combination to be made of such bases and tops as may be most desirable for the work in view. The Standard voltmeter, as represented, is used for both alternating and direct current work, but the instrument scaled for direct current is not the exact scale for alternating current, or vice versa, but the same form of instrument is used for any kind of work calling for measurement of potential. In addition to the pictures which are shown of the Standard apparatus in detail, a number of drawings, dimension diagrams, tables and examples of working installations are comprised in the contents, among the latter being the reproduction of a photograph of the World's Fair arc lighting service plant, consisting of 22 50 light 2,000 candle power dynamos. The Standard company is to be congratulated upon working out its system so carefully and completely and upon its success in so ably illustrating it in book form.

BUSINESS.

The Wallace Electric company, Chicago, has purchased the entire remaining stock of the Ansonia Electric company, and has a large force busily engaged in removing it to its Dearborn street store.

The Clonbrock Steam Boiler Works, Brooklyn, N. Y., have closed the contract for a battery of boilers aggregating a capacity of 4,000 horse power with the Edison Electric Illuminating company, Pearl street, Brooklyn.

The Automatic Switch company, Baltimore, Md., has established the following agencies: Boston Electric company, 548 Washington street, Boston; Michigan Electric company, 47 State street, Detroit; Duquesne Electric Supply & Construction company, 709 Lewis Block, Pittsburg.

The northwestern headquarters of the Siemens & Halske Electric company of America will hereafter be at 939 Lumber Exchange, Minneapolis, Minn. The company manufactures and sells high class electrical machinery for lighting, street railway and power transmission, and furnishes plans, specifications and estimates.

The Central Electric company, Chicago, has broken its record for the sale of fan motors. The hot weather always gives the sale thermometer an upward tendency, and last week it went up to its highest degree very rapidly. The motors handled by this company are of Lundell manufacture, and are carried in stock in a variety of designs and sizes. This fan motor has been widely introduced, and its popularity may be judged from its recent heavy sales by the Central company.

The Allen-Hussey company, 818 Medinah building, among recent contracts, secured those for wiring the Equitable building and the new Academy of Sciences at Lincoln Park, Chicago. The company has received a warm testimonial from the Lakeside Club for the excellence of the work done upon the club's house.

The Stanley Electric Manufacturing company, Pittsfield, Mass., whose two-phase alternating current system was illustrated in the last issue of this journal, reports numerous inquiries regarding the apparatus, showing a widespread interest in the subject. The company reports considerable increase in the volume of business at its Chicago office.

The Goubert feed water heater is in high favor among steam users generally, and is especially valued for service in connection with electric street railway plants. The Goubert Manufacturing company, sole manufacturer, 14 Cortlandt street, New York, N. Y., has installed its heater in the principal lighting and traction plants of the country.

The Johns-Pratt company, for whom the H. W. Johns Manufacturing company, New York, is the selling agent, is pushing the delivery of trolley line insulating materials for 43 miles of road recently contracted for by the Hartford Conn., Street Railway company. The Johns-Pratt company is also the manufacturer of Vulcabeston, Monarch and other insulating materials.

Huebel & Manger, 286–290 Graham street, Brooklyn, are obliged to add to their present force of help to keep up with the large number of orders that are received for their electrical goods. The new improved style F iron frame pivoted armature bell is having a large sale, as it meets the requirements for use in hotels, factories and large buildings for fire alarm and other purposes.

The Phosphor Bronze Smelting company, Philadelphia, Pa., has a number of specialties in its elephant brand phosphor bronze alloys which are generally in favor among machinery men. The elephant brand hardened castings are made by special process, applicable mainly to duplicate work, and possess great tensile strength and rigidity, with hardness almost equal to steel. The phosphorized anti-friction metal manufactured by the company is a superior lining metal to be used in the same manner as babbitt metal for heavy pressure and high speed.

The warm weather of last week proved to be a great factor in the sale of fan motors, and the Metropolitan Electric company reports that its stock of Crocker-Wheeler motors was quickly sold out but which, however, has been quickly replenished. One specialty which this company carries in stock in the Chicago store is the Vulcanized Fiber company's product in sheets, tubes, rods, sticks, etc., a convenience which will be appreciated by consumers. This is true of the Kester arc lamp, for which the Metropolitan company is general western agent, and a number of styles of ornamental lamps may be inspected in the store at any time.

The demand for the Packard Mogul lamp, adapted particularly for outside work, has induced the company to make arrangements to furnish a special street hood particularly designed for the Mogul lamp, so that it can be used safely and conveniently for outside work, and the Electric Appliance company, Chicago, hopes to have some of the new street fixtures on exhibition in its salesrooms soon. The company has been extending the field of usefulness of its latest specialty, the Allen soldering stick, by making arrangements with the principal supply dealers in nearly every section of the country to push its sale and carry a considerable stock.

The Washington Electric company announces that it is doing a good business in its new quarters at 207 South Canal street, Chicago. It will be remembered that the Washington Electric company was the concern organized by Louis Stein and W. O. Meissner about a year ago to manufacture the Meissner focusing lamp and the Washington alternating incandescent arc lamp now so well known to the trade, beside a number of other valuable specialties. The company, however, was recently reorganized, Mr. Stein disposing of his interest and Merrill Watson joining hands with Mr. Meissner to carry on the business. Under the present organization Mr. Meissner holds the office of president and Mr. Watson is the secretary of the company. The Washington Electric company not only does a manufacturing business, but also pays attention to high class repairing in the line of instrument work, etc. Its prospects are bright.

Charles G. Armstrong, Auditorium tower, Chicago, electrical engineer and architect, has prepared the specifications and supervised the installation of a large number of electrical plants in and about Chicago during the last year. Among some of these may be mentioned the plants in the Renfost building, Kenwood apartment house, Heisler & Young bakery, Lakota Hotel, University of Chicago, Illinois Central depot, Ellsworth building, Meyer building, Auditorium Annex, Butterfield building, Athletic Association building, Newberry Library, Produce Cold Storage Exchange and the Huck & Young, Hartford, Teutonic, Schiller and Stock Exchange buildings, as well as the Academy of Sciences and the plant of the South Park commissioners. These plants are all of 1,000 or more lights capacity. Outside of Chicago some of the more important plants for which Mr. Armstrong drew specifications are those in Monticello, Carthage, Maroa, Decatur and Sandwich, Ill.; that of the Columbia building, Louisville, Ky., of the Wainwright, St. Nicholas and Union Trust buildings in St. Louis, the power transmission plant of Whitman & Barnes, West Pullman, and a great many others.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued June 12, 1894

521,103. Contact Trolley. Robert W. Hawkesworth, East Orange, N. J.

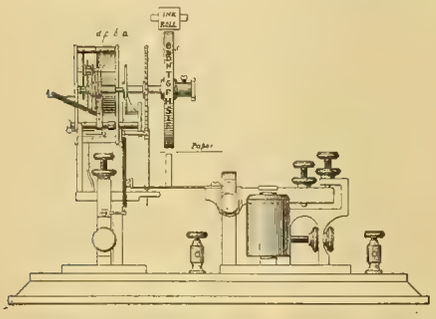
The device patented is intended to do away with the necessity of breaking contact between the trolley and trolley wire in an overhead system of electric traction when the end of a route is reached, or for some reason it is desired to change the direction of the motion of the car. It consists of constructing the trolley bar with two arms, connected by a spring in such a manner that when one arm is pulled down and secured by the operating cord the other will be held up against the trolley wire with a spring contact, and will yield to any inequalities without losing its contact with the wire, or without danger of breaking the bar in case any fixed object should be struck.

521,168. Thermo-electric Battery. Ernst W. Jungner, Skara, Sweden.

This thermo-electric chain battery is more particularly adapted for use with electric fire alarms, but it may be used for other purposes. The construction of the battery comprises a series of elements held together, and each composed of two strips, preferably wires of different metals. The alternate joints are suitably insulated by means of a non-conductor of heat. The length and diameter of the metal strips may be greatly varied, according to the uses to be made of the chain. The inventor has found that, when the thermo-electric chain battery is to be used in connection with electric fire alarms, excellent results are obtained by using copper and iron wire of a diameter of about 1 to 1.5 millimeters, and of a length of about 40 to 50 millimeters, forming elements of from 70 to 80 millimeters, or from 15 to 20 elements to the running meter of chain.

521,170. Printing Telegraph. Oscar L. Kleber, Pittsburg, Pa.

The invention consists of a systematized class arrangement and grouping of telegraphic signals with corresponding class groups of alphabetical letters, numeral characters, punctuation marks, etc., in combination with an organized mechanism by which transmitted telegraphic signals of Morse's system are caused to produce and print such matter as is sent over a telegraph line. The accompanying drawing represents a front elevation of the inventor's mechanism. The letters and numerals on the type wheel 5 are relatively so arranged as to correspond with certain points or positions on the selecting disks *a*, *b*, *c*, *d*, and respond to Morse signals made upon them, so that the letter or numeral corresponding to its Morse signal must move and coincide in point of time, and therefore take a predetermined position.



NO. 521,170.

521,183. Police Signal Telegraph System. Charles A. Rolfe, Chicago, Ill.

The primary object of the inventor is to secure the sending of an alarm of fire, no matter how careless, ignorant or hasty the person opening the signal box may be.

521,188. Magneto Telephone. Alfred Stromberg and Andrew Carlson, Chicago, Ill.

The invention consists in a cheapened method of constructing a telephone, for which a patent has been issued, comprising a magneto generator provided with soft iron polar projections, around which the telephone coils are wound, and opposite the ends of which the diaphragm is located. It is proposed to construct the magneto generator of parallel disposed bar magnets, and providing between the magnets at one end pole pieces, between which the armature is adapted to rotate.

521,220. Electric Telephone. Wilton L. Richards, Malden, Mass.

The idea of the invention is to produce a telephone which, while being sensitive to sounds originating at some distance from the instrument, shall at the same time remain uninjured by powerful tones originating close at hand. The current changing material—finely divided carbon *M*—is placed within the chamber *C* in the sectional drawing. In order that the pressure of the air may be equal on both sides of the front electrode, the inventor forms the flexible disk *g* of extremely fine wire gauze, and between its surface and the surface of the slate casing to which it is secured a very thin washer of porous paper is interposed, which serves as a cushion without materially hindering the sufficient passage of air. The gauze disk *g* supports the front electrode, and completely closes the front of the chamber, retaining the granular conducting material in the chamber between the electrodes. The instrument when in use may be suspended by a light stirrup *s* from cords. The compound button *B* has its front electrode rigidly attached by means of nuts to the wooden diaphragm, while the back electrode rests in its support on the frame, and is comparatively loose. The results of the operation of the instrument are therefore largely due to the inertia of the slate casing, and probably to a considerable extent also to the simple agitation of the granular carbon contained in the button.

521,238. Bond for Electrical Conductors. John Herr, Philadelphia, Pa.

The bond consists of a split tapered bolt which is furnished with a hole passing longitudinally through its center, and the exterior end of the shank of which is threaded, and which is furnished with a head adapted to be grasped by a wrench or spanner, and of a nut adapted to be screwed up on the tapered shank of the bolt in order to close it down upon the wire and to hold it in place upon the rail.

521,239. Burglar Alarm. Clement R. Hoopes, Ogontz, Pa.

The object of the invention is to provide an attachment to chain bolts upon doors, so that an alarm is sounded upon any attempt being made to manipulate the bolt. Contact points upon the bolt, an electric circuit and an annunciator are employed.

521,260. Electric Battery. Fred Dubero and Peter Mohrdieck, San Francisco, Cal.

The object of this invention is to provide a continuous or constant battery, the elements of which are renewed during the operation of the battery, and in the employment in conjunction with the battery of sea water as the active energizing element. In its construction any suitable or desirable substance is employed, which will form the positive and negative elements of the battery. These elements are so arranged with relation to each other that the negative element may be alternately submerged in the active solution in which the positive element remains submerged, and then withdrawn and exposed to the air to become dry and to absorb a certain portion of air before it is again submerged. A very suitable method is to make the negative element in the form of a rotary hollow cylinder.

521,269. Core Attracting Solenoid. Wenzel R. Michl, Wetter-on-the-Ruhr, Germany.

The invention relates to the combination of a solenoid and of a movable iron core designed to be attracted by and drawn into the solenoid, and the object of the improvement is to render the action of the solenoid on the core uniform throughout the course of the latter. If the coils of wire constituting a solenoid are arranged uniformly in all portions of it, and if the transverse sections of the core are all alike, the core, when introduced with one end into the solenoid energized by an electric current, will be drawn in with a force which increases until the end of the core has arrived at or near the center of the solenoid; thereupon the attracting force will remain constant for a short distance, and finally it will decrease again. In order to render the force uniform, the inventor winds the coils of the solenoid in such manner that the number contained in consecutive sectional portions of the same length decreases from the core introduction end to the middle of the solenoid, and then increases again.

521,274. Telephone Switch. Joseph B. Smith, Manchester, N. H.

The device patented is a positive one, and is independent of springs, weights or the gravity of the telephones, and is simple and effective. The invention comprises an improvement in switches for telephones, and has for its object the putting of a telephone positively into or out of the line circuit by removing the telephone from or replacing it on its support on the call box of the instrument.

521,303. Busy Test for Multiple Switchboards. James A. Wotton, Atlanta, Ga.

This device is for use in making busy tests on a multiple switchboard in exchanges in cities where there is considerable induction from exterior electric conductors, such as, for example, electric street railways, in which the ground return circuits interfere with conduit telephone systems.

521,311. Trolley Wire Finder. Theophilus E. Gressle, Indianapolis, Ind.

The invention is designed to guide the conducting wire to the groove of the trolley after the latter has been shifted, by which rapidity and ease in again causing contact to be made between the trolley and conducting wire are accomplished. The invention is also designed to admit of the required reversibility of the trolley support necessary in changing the direction of the car, and to effect the automatic readjustment of the parts to normal position.

521,322. Incandescent Lamp Socket. Luke R. Peck, St. Johns, Mich.

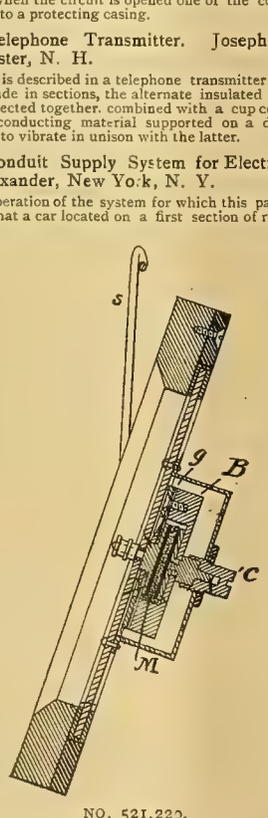
The invention consists in the construction of a lamp socket made in detachable sections, to the upper section of which the terminals of the conductors are secured with suitable contacts, and the lower section detachably engaging with them. It further consists in the construction of the frame comprising on the detachable section suitable fusible strips, and in the peculiar construction and arrangement of the lamp contacts and switch, so that when the circuit is opened one of the contacts is withdrawn into a protecting casing.

521,325. Telephone Transmitter. Joseph B. Smith, Manchester, N. H.

There is described in a telephone transmitter a multiple electrode made in sections, the alternate insulated layers of which are connected together, combined with a cup containing finely divided conducting material supported on a diaphragm, and adapted to vibrate in unison with the latter.

521,326. Conduit Supply System for Electric Railways. Harry Alexander, New York, N. Y.

The operation of the system for which this patent was issued is such that a car located on a first section of road will receive current directly from the first section of a working conductor through a collector resting on the conductor, and through insulated conductors which pass up to the car. When the car reaches the end of the first section of the working conductor a supplementary contact device, which is electrically connected with the collector, makes contact with a supplementary contact conductor, thereby diverting current from the working conductor through a switch magnet to the rail, operating the switch and connecting the supply conductor to the second section of the working conductor. When the car reaches the second contact conductor the second switch is operated, connecting the continuous supply conductor to the third section of the working conductor, and when the car reaches the contact conductor current is diverted through the magnet of the first switch, thereby breaking the connection between the supply conductor and the working conductor at that switch, and so on throughout the length of the line.

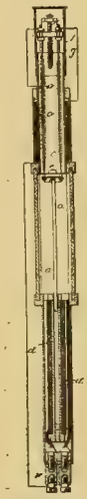


NO. 521,220.

521,362. Electric Arc Light for Magic Lanterns. Charles Beseler, Jersey City, N. J.

The invention, which is mostly applicable to details, provides a new and improved arc light for magic lanterns, which will be simple and durable in construction, and arranged in such a manner as to enable the operator to conveniently and accurately adjust the light relative to the condenser of the magic lantern in order to produce the best results upon the screen.

521,394. Apparatus for Measuring and Recording Electric Currents. William Thomson, Glasgow, Scotland.



As a simple instrument for measuring electric currents the invention uses a permanent or electro-magnet attracted by a fixed solenoid *d*, and carrying a pointer which moves past a graduated plate or scale, and this magnet is suspended in the proper relation to the fixed solenoid by two fine oppositely coiled spiral springs *c c*, which, in the use of an electro-magnet, form the conductors for its helix. The current to be measured passes through the fixed solenoid, attracting inward the movable magnet *a a* with a force which is very nearly the same at all times for the same strength of current through the fixed solenoid, and very nearly proportionate to the strength of this current through a wide range of motion of the movable magnet within the fixed solenoid, provided that the electro-magnet is kept magnetized nearly to saturation. Thus the strength of the current through the fixed solenoid may be very approximately read off on the straight scale of equal divisions, indicating the distance through which the movable electro-magnet is pulled against the force of its bearing springs when it is hung as described. To measure the total quantity of electricity, with this simple instrument is combined a counter or recorder, which is actuated at periodic intervals of time by a constantly revolving cam, through the medium of a projection carried on, and thereby controlled in its position by the electro-magnet, which is in turn determined in its position by the strength of current passing, and the relation of the parts is such that the extent of movement of the recorder at each impulse varies according to the extent of previous depression of the magnet with its projection; or, in other words, depends on the strength of the current passing.

NO. 521,394.

521,396. Electric Clock Winding Mechanism. Adolph E. Vidal and Gaston Hervieu, London, England.

The invention relates to electrical winding mechanism for clock movements, and its object is to wind up automatically the spring or weight at intervals to the same extent as either have become unwound during a short time of working.

521,412. Track Circuit. Louis F. Johnson, Poughkeepsie, N. Y.

This invention relates to electric signaling systems for railways of that general class in which a circuit is completed from one line of rails of a section to the other line of rails through the wheels and axles of the car which may happen to be on such a section, and provides means for obviating the difficulties found to be inherent in such systems resulting from destroyed insulation or short-circuits in damp weather.

521,422. Telephone Call Recorder. William F. Smith, San Francisco, Cal.

This invention has for its object to transmit telegraphically from a subscriber's station to the operator at a switching station the number of another subscriber's station with which connection is desired, and it is designed to take the place of the present mode of transmitting these numbers orally. The invention consists of a printing mechanism at the switching station, constructed and arranged to print or mark in suitable characters upon a tape or paper strip the figures or characters composing the "call," and mechanism located at the subscriber's telephone to actuate the printing mechanism telegraphically.

521,423. Automatic Electro-magnetic Cut-out. Lucius T. Stanley, Brooklyn, N. Y.

The invention comprises in an electro-magnetic cut-out the combination of a vertically movable magnetic plunger having a pole plate at its lower and a non-magnetic extension at its upper end, a coil surrounding the plunger, a magnetic casing surrounding the coil, and a pivoted switch lever in position to be encountered and raised by the non-magnetic extension of the core on its upward movement.

521,434. Duplex Electric Arc Lamp. George F. Edens and John B. Brewer, Xenia, O.

The invention relates to trip mechansim for duplex arc lamps, and its objects are to provide means by which either set of carbons may be consumed first instead of being confined to one particular set; and also to so arrange the parts that the feed rod of either set of carbons will automatically complete the arc in the adjacent set during its downward movement. A further object is to provide means for controlling the trip mechanism from without the casing. The purpose is to provide a trip lever for each feed rod, this lever engaging with one of its ends a portion of the feed rod, and having its opposite end arranged in the path of movement of the adjacent feed rod; also in providing each lever with means arranged without the casing for controlling the movement of the levers. The invention further consists in certain features of construction and combinations of parts.

521,435. Automatic Electric Signal Lamp. John R. Farmer, St. Louis, Mo.

This invention consists in a hood which is to be suspended in an electric overhead trolley system over the trolleys where two or more trolley lines cross each other, and it is so arranged that suspended from the hood there is an ordinary signal lantern having four lights, the alternate ones being white and red as is usual in junction lamps. The operation of the signal consists in turning the lamp one-eighth of a revolution in either direction, according to the direction of the approaching car. This is accomplished by an electric connection which is formed by the trolley of the electric car, which closes the circuit through the magnet in the hood and turns the lamp one-eighth of a revolution, turning the white light in a direction parallel to the movement of the car, and the red light facing the direction of the cross lines.

521,436. System of Electrical Distribution. Thomas J. Fay, New York, N. Y.

The inventor claims in a multiple series system of distribution the combination of a main generating station, two main conductors leading from it, an intermediate or compensating conductor between the groups or sets of translating devices, two generators connected in series with each other and normally tending to augment the supply of current to the mains, but so connected as to supply extra current to either group of translating devices, which requires it in order to establish a balance between the two groups, and an electric motor driving both generators and supplied with current from the mains.

Western Electrician.

EVERY SATURDAY.

Vol. XIV. CHICAGO, JUNE 30, 1894. No. 26

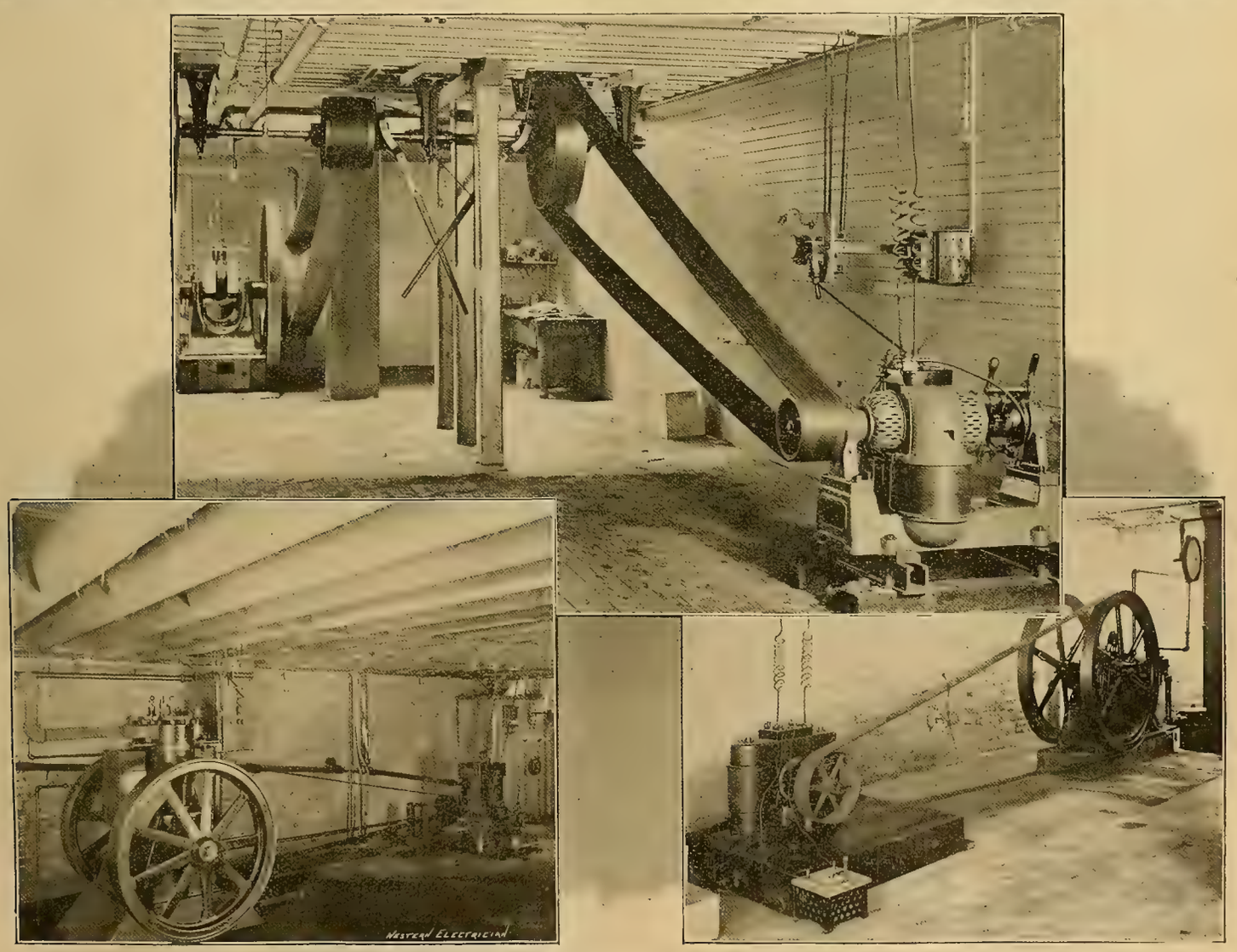
Some Electric Plants in Chicago Driven by Gas Engines.

The demand for isolated electric light installations has opened a field for a cheaper and more convenient primary source of energy than found in the consumption of coal to supply the steam engine. In the smaller plants isolated from a central station supply and without steam and boiler facilities the gas engine has for some time been attracting attention and giving favorable results. The advantages claimed for it over steam engines fired with either coal oil, wood or coal are now being thoroughly investigated in this country. It is pointed out that no tedious preparation is required before starting; there is no chimney to build, and no smoke nuisance, no coal to lay in or ashes to cart away, no dust and no boiler, no safety-valves and water-gauges to watch, no fires to slack or bank at stopping time, no regular attendance required beyond oiling, cleaning and starting; and, beside all these advantages it is claimed that there is great economy as compared with steam engines or any power of equal size.

Without entering into the comparative merits of the several types of gas engines which are upon the market in the United States, it is the intention in this article to illustrate different types of gas engines installed in Chicago for the purpose of running electrical machinery. The work of these plants will give some idea of the flexibility of the gas engine and of the varied applications to which it may be applied.

In Fig. 2 upon this page is presented a general view of the power plant of the Wakefield Rattan company, 220 Wabash avenue. Here is installed a gas engine of the White & Middleton type, of 25 horse power capacity, driving by means of main line shafting and counter shafting a dynamo for lighting the premises and a five horse power Reedy elevator, beside pumping air which is used in starting the engine. An engine of this type and size weighs about 6,000 pounds, and has a length of 10 feet. The Siemens & Halske dynamo shown in the foreground gives 90 amperes at 1,190 revolutions, and is at present running 12 Siemens & Halske arc lights and between 40 and 50 incandescent lamps of the same make. In spite of the change in load upon the engine when the elevator is in service, the lights burn without apparent unsteadiness, and the voltmeter seldom varies to a greater extent than two volts. The instrument is a magnetic vane voltmeter of Queen & Co.'s manufacture. The engine is belted to an 18 inch pulley on the shaft and the dynamo to a 36 inch pulley. The elevator driving machinery, not shown in the picture, is upon the main line shaft and consists of worm gearing and sheave apparatus. Natural gas is piped direct to the engine from the mains in the streets. It may be said of the White & Middleton engines that they will run, without any alteration, on either natural or artificial gas. They are also superior in economy and efficiency as gasoline engines. They are made from 3½ to 55 horse power, and have no valves to grind in with emery or slide valves which require scraping and cleaning. The igniter is a very simple and durable device, with no springs or mechanism of any kind to control it. The governor is also a simple and substantial device attached directly to the crank shaft; it insures regular speed under varying loads, and controls the quantity of gas for amount of work done. There is no other mechanism attached to the crank shaft to control the movements of the engine except the governor, which makes the engine extremely simple. The engine is furnished with automatic oilers on all working parts, and requires about the same grade of lubricating oil as an ordinary steam engine. It is not slighted in any manner in the way of construction, crank shafts, connecting rods and other working parts being made of the very best open-hearth forged steel and having heavy bronze metal bearings. The iron castings are made from the very best charcoal iron which can be secured.

No less interesting in its operation is the plant in the basement of the clothing establishment of Mickel & Pitzele, 767 South Halsted street, for here a Raymond gas engine is driving an Edison 12 kilowatt dynamo belted direct without the intervention of shafting. It is of about 15 horse power capacity and at the present time the dynamo is supplying a large number of incandescent lamps as well as



FIGS. 1, 2 AND 3. SOME ELECTRIC PLANTS IN CHICAGO DRIVEN BY GAS ENGINES.

a number of arc lights. As seen in Fig. 1 the engine is of the vertical type, and is intended for high speed work. One of the advantages claimed for this engine is its electric ignition, which is operated by primary batteries and insures regular ignition and avoids objectionable smell and waste of gas. The plant requires a minimum of attention, and is making a record for electrical efficiency. A switchboard furnished with Weston current indicating instruments is shown back of the dynamo.

Another application of a gas engine directly belted to

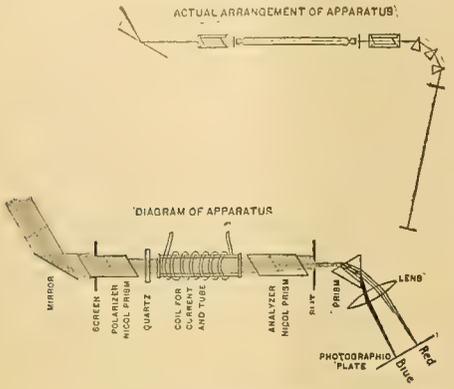


FIG. 1. A RELIABLE METHOD OF RECORDING VARIABLE CURRENT CURVES.

a dynamo is illustrated in Fig. 3. In this plant, which is located in the basement of 245 Lake street, a seven horse power Otto engine drives a Rockford dynamo, which, at the present time, is supplying about seventy 16 candle power incandescent lights. This engine has most of its working parts upon the outside, readily accessible, and is provided with a reliable electric and practical magnetic igniter. It is of the type 4b and utilizes the four stroke cycle. The engine is supplied with natural gas from the streets, and is a fine illustration of the convenience and practicability of such an installation. In design the engine is small and pleasing in appearance, and the whole plant may be placed in a remarkably small space.

These installations have been taken as examples of the usefulness and evident economy of gas engines in comparatively small plants, but many examples may be had of much larger engines being used for electric lighting. Waukesha, Wis., has a 100 horse power gas engine to operate its system, and Racine, Wis., possesses two 50 horse power engines for the same purpose. In Milwaukee there are a number of Otto engines driving electrical machinery, and there is no reason for doubting that with increased efficiency and continued development they will increase rapidly in Chicago business establishments. Several gas engine installations in Chicago have already been described and illustrated in the columns of the journal.

Electric Coal Mining in Kansas.

An electric coal mining plant has been established at Boicourt, Kas., in the colliery of the Bradley-Vernon Coal

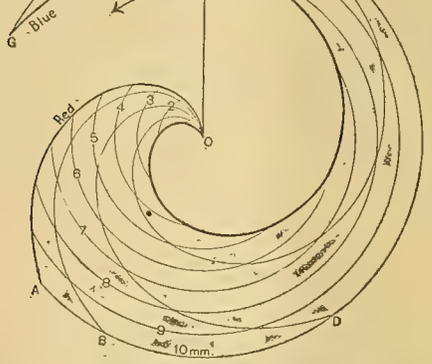


FIG. 2 A RELIABLE METHOD OF RECORDING VARIABLE CURRENT CURVES.

company. Two electrically operated coal cutters are at present employed, each machine having a capacity to undercut 30 inches of coal 400 lineal feet in a day. Current is supplied to the motors on the coal cutters by an 85 horse power 220 volt generator, which is of sufficient capacity to operate four cutting machines of the size in use. The plant has thus far given very satisfactory service. The electrical machinery is of the standard type of mining equipment made by the General Electric company, the sale having been made by the Chicago office of that company.

A Reliable Method of Recording Variable Current Curves.[1]

By Dr. Albert C. Crehore.

INTRODUCTION.

A practical problem that has in more recent years presented itself to the electrician and physicist alike is "How shall we measure the exact current which flows in a conductor at any instant of time and record all the irregular changes to which it is subject?" Probably everyone who has thought of such matters at all has considered this problem in some of the phases which it presents. The importance of the question since the introduction and extensive use of the alternating current has emphasized the fact that we need a "reliable method" of measuring the instantaneous values of a variable current, which is not a "method by points," but "a method which continuously records the current."

Under "a method by points" is included any method in which the current is obtained from readings (usually of an electrostatic voltmeter) due to the charge of a condenser which may be connected in at any point of time. The essential characteristic of the method is that the current is supposed to repeat itself exactly during successive periods, or more generally when the conditions are exactly repeated. There can be no doubt that the current does repeat itself under exactly similar conditions, but can we be sure that those conditions are exactly repeated? By this method a number of points are found, the time occupied being at least several minutes, and the collection of points properly arranged is a representation of the current during as short a time as the one-hundredth of a second, perhaps. Yet this method has proved to be a very useful and practical one, and has given us information concerning the currents and potentials of generators and transformers which is of paramount importance. Yet all will agree that this "method by points" is too limited in its application, and does not show us any sudden temporary

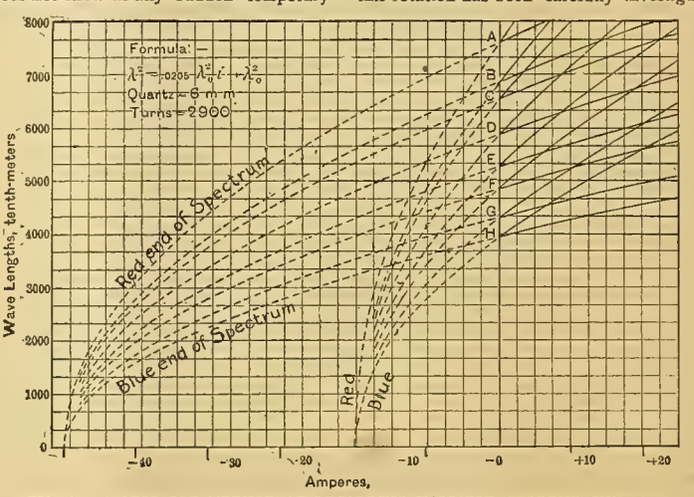


FIG. 3. A RELIABLE METHOD OF RECORDING VARIABLE CURRENT CURVES.

change taking place in a current, which does not repeat itself. Such, for instance, as a sudden "make" or "break," or "change" in an alternating current, would not be easily shown by this method. The second method, previously designated "a method which continuously records the current," is the one to which this paper more particularly refers. Under this head is included all methods which attempt to record the current by causing it, either directly or indirectly, to move a material something so that its displacement is some single valued function of the current. As an example of this method may be mentioned the well-known experiments of Froelich, in which a telephone is used, upon the disk of which is mounted a mirror that permits a beam of light to be reflected from it. Any vibration of the disk gives an angular motion to the ray of light, and this motion is in turn recorded upon a moving photographic plate. Other examples might be mentioned in illustration of this method; for instance, a wire which is deflected in a magnetic field, or stream of mercury so influenced; but it will be noticed that in all of these cases an appreciable amount of ponderable matter is required to be moved backward and forward during each reversal of the current. When the current reverses hundreds of times per second, the unavoidable difficulty is introduced that the forced oscillations of this ponderable matter, no matter how small in amount, become so superimposed upon those of the current which it is desired to measure that they are inseparably mixed together, and the record does not show the true current, but the resultant vibrations of the instrument. That this is the case with the method of the telephone, above referred to, has been established beyond a doubt, it seems, by experiments conducted at Cornell University by Henry Floy. The current furnished to the telephone was carefully measured by the "method by points," and care was taken to see that the current as measured by points was the same as that used in the telephone. The vibrations of the telephone did not even approximately agree with the current as measured by well-established methods.

Bearing these points in mind, and remembering the high frequency of some of the oscillations which it is desired to record, may we not with some degree of certainty predict that any of these methods requiring the rapid motion of ponderable matter will be open to precisely the same objections which are noticed in the case of the telephone? Without answering this question, probably all will agree that the difficulty may certainly be avoided by using as a vibrator, instead of this so called "ponderable matter," a vibrator that has no weight. It is to this question of finding a form of vibrator without weight that I invite your attention.

THE WEIGHTLESS VIBRATOR.

The idea of the weightless vibrator is perhaps already suggested in the beam of light. But how shall we cause a beam of light to have a change in direction simply by means of a current flowing in a circuit without the intervention of some moving material? A way of influencing a beam of light directly by an electric current (or more properly by its magnetic field) is that discovered long ago by Faraday. It is by means of the discovery of the rotation of the plane of polarization by an electric current that I propose a method of obtaining a weightless vibrator. The explanation will be made clearer by reference to the diagram of apparatus, Fig. 1. A beam of light is passed through a polarizer (Nicol prism) so that the vibrations of the beam take place in only one plane upon emergence. If it is then passed directly through an analyzer (Nicol prism) the latter may be set at such an angle as to prevent all light from passing through it, and thus produce darkness beyond the analyzer. Faraday's discovery was that, if a beam of polarized light is passed through some substance in the direction of the lines of magnetization within that substance, there is a rotation of the plane of polarization in a direction which is the same as the direction of the current required to produce such a magnetic field. The direction of rotation is unaltered, therefore, whether the light beam advances in the same or the opposite direction to the magnetization, so that a beam reflected back and forth through the substance several times has its rotation increased by equal amounts each time. If the direction of the ray of light be at right angles to the lines of magnetization there is no rotation produced. The amount of this rotation has been carefully investigated by Verdet, who announced laws by which it may be expressed. They are summed up in the following statement: "The rotation of the plane of polarization for monochromatic light is in any given substance proportional to the difference in magnetic potential between the points of entrance and emergence of the ray," That is, it is equal to a constant times this difference of potential and is expressed by the formula

$$\theta = v\,V. \qquad (1)$$

where θ=angle of rotation, V=difference in magnetic potential, and v for a given wave-length is constant in any one substance. This constant is known as Verdet's constant. If now the light is passed through polarizer and then through a tube containing the substance used, around which is wound a coil of wire, and thence through the analyzer, an observer would find complete darkness upon looking through the analyzer when set in the crossed position. But if without moving the analyzer a current is sent through the coil on the tube, light appears to the observer. This is because the plane of polarization has been rotated by the current and practically the prisms are no longer crossed. Now let the analyzer be rotated while the current is still flowing, and the observer will see a series of beautiful colors through the analyzer, a different one for each position of it; but, as long as the current flows, he cannot produce darkness again by any amount of rotation of the analyzer.

This effect suggests what is known to be a fact, that the different wave-lengths composing white light are rotated by the current in different amounts, so that when the analyzer is turned to the angle corresponding to the yellow light, say, only the yellow light is prevented from passing through the analyzer. All the other rays, being rotated by different amounts, pass through the analyzer, and there being mixed together they give rise to the series of beautiful complex colors above mentioned. A different color is seen for each position of the analyzer because in each position a different color is subtracted from white light, and the observer sees what is left or merely the complementary color.

The law which tells the amount of rotation given to the different colors is pretty accurately known; and theory in this case is in close accord with the observed facts. The equation which closely expresses the amount of the dispersion for the different wave-lengths may be written:

$$v = c\,\lambda^3/\lambda^2\left(1 - \frac{\lambda}{n}\frac{dn}{d\lambda}\right), \qquad (2)$$

where v is the so called Verdet's constant, λ the wave

1. Read before the American Institute of Electrical Engineers, Philadelphia, May 17, 1894.

length, and n the index of refraction of the medium; c is a constant for any one medium, which is, however, inversely proportional to the permeability of the medium. This is a formula at which Maxwell arrived from his theory of molecular vortices, and we shall see how closely it is in accord with observation. We see by this formula that Verdet's constant depends not only upon the wave length, but upon the index of refraction corresponding to that particular wave length, and also upon the rate of change of the index with respect to the wave length. If this rate of change of n with respect to λ is small, as would be the case with a substance where the dispersion is small and the index of refraction regarded as approximately constant, then it is seen that the formula reduces to an extremely simple form, viz.:

$$v = \frac{c^1}{\lambda^2} \qquad (3)$$

Here Verdet's constant is inversely proportional to the square of the wave length. Using this approximate form for the present, we see from Verdet's law, equation (1), that

$$\theta = vV = c_1 \frac{v}{\lambda^2} \qquad (4)$$

But the difference of magnetic potential, v, is $\frac{4\pi_1 \cdot Si}{10}$, where Si is ampere turns, and thus we have

$$\theta = 4\pi c_1 \cdot Si / 10\lambda^2 = c_2 i / \lambda^2. \qquad (5)$$

where

$$c_2 = 4\pi c_1 \cdot S / 10 \qquad (6)$$

A reference to Fig. 2 will show this relation between angle of rotation, wave length and current. Several spirals are shown corresponding to the several lines of the spectrum, known as *A*, *B*, *D*, *F*, and *G*. The radii of the circles which intersect these spirals are proportional to the current flowing in the circuit, while the angle, which the radius, drawn to any point of intersection, makes with *O P* represents the rotation for that particular wave length and current. The red and blue spirals indicate that the red rays are not rotated so much as the blue. The direction of rotation in the diagram is as indicated by the arrow. Now, returning to the observer looking through the analyzer, if he could resolve the light there seen into the pure colors of the spectrum, what he should expect would be, with no current, a complete spectrum, since all rays are rotated by the current. But let him rotate the analyzer, and he finds that first one color then another disappears, and a dark band is seen to move across the spectrum as he rotates the analyzer. Again, let him rotate the analyzer to a certain angle and leave it there while he varies the current. He should expect that the band would move, but would vanish entirely with zero current, and thus prevent observation for small currents.

Fortunately we have substances which naturally rotate a beam of polarized light, for by means of this aid we may obviate the difficulty that the band vanishes with no current. For instance, a parallel plate cut from a crystal of quartz perpendicular to the optic axis has this property of rotating the plane of polarization. Quartz is selected for the material used because of its great transparency and high specific rotary power. The law of the rotation is similar to that already mentioned for the rotation by the current. The approximate law is that the rotation is inversely as the square of the wave length, which may be expressed:

$$\phi = c_3 e^3/\lambda^2, \qquad (7)$$

where ϕ is the angle of rotation for the wave length λ, and e is the thickness of the plate. The thickness of the quartz plate is seen to correspond to the current in equation (5). Fig. 2 represents the actual rotation for different thicknesses of quartz, each circle corresponding to a plate one millimeter thick. The equivalent of a quartz plate one millimeter thick is represented by 35,700 ampere turns wound upon a tube containing carbon bisulphide. This latter is the substance used, being selected on account of its high transparency and specific rotation.

If a quartz plate be placed between polarizer and analyzer the effect is the same as if the current circulated around the tube of carbon bisulphide, and we may by rotating the analyzer move the dark band completely across the spectrum by means of the quartz plate without any current. But suppose we set the analyzer so that the dark band remains in the center of the spectrum, and then pass a current through the coil. We observe a motion of this dark band back and forth through the spectrum as the current is repeatedly reversed. For any given current its position is always the same, so that its motion may be calibrated by passing known currents through the coil. Have we not in this found a weightless vibrator that is sure to move in unison with the currents, if the term is allowed?

Before passing on to the more practical side of the question, it may be asked, will this band move back and forth so that its displacement is approximately proportional to the current? The answer to this question lies so near at hand that your attention is invited to it for a moment. The rotation of the plane by quartz is approximately represented by the formula:

$$\phi = c_3 \frac{e}{\lambda^2}.$$

The rotation by the current is represented by

$$\theta = c_2 \frac{i}{\lambda^2}.$$

If both these rotations take place together, the resultant is merely the sum of the components, and

$$\chi = \phi + \theta = (c_3 e + c_2 i) \frac{1}{\lambda^2}. \qquad (8)$$

The position of the dark band depends upon the position of the analyzer. Let the analyzer be set at some convenient angle, α, with the position of complete darkness, and let it remain there. Then the wave length or color where the dark band occurs for the quartz plate (being called λ_0) is given by (7) above, and we have

$$\alpha = c_3 \frac{e}{\lambda_0^2}. \qquad (9)$$

The wave length corresponding to this constant angle, α, when both quartz and current are used, is given by (8), and we have

$$\alpha = (c_3 e + c_2 i) \frac{1}{\lambda^2}, \qquad (10)$$

in which λ is that wave length corresponding to a certain

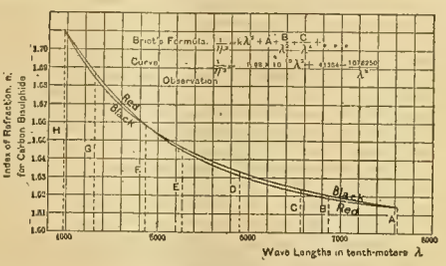


FIG. 4. A RELIABLE METHOD OF RECORDING VARIABLE CURRENT CURVES.

current, i, and therefore i and λ are co-ordinate variables. Equating the values of α, we have

$$\frac{c_3 e}{\lambda_0^2} = \frac{c_3 e + c_2 i}{\lambda^2}. \qquad (11)$$

This may be written

$$\lambda^2 = \frac{c_2 \lambda_0^2}{c_3 e} i + \lambda_0^2 \qquad (12)$$

and in this form the relation between wave length and current is seen to be represented by a parabola. In Fig. 3 are represented two sets of parabolas obtained from equation (12) by assuming that λ_0 and e take in succession different values. It will be remembered that λ_0 represents that wave length corresponding to the position of the dark band for no current. It is therefore the value of λ, when i is equal to zero, as appears from the equation independently. The axis of λ is the vertical line to the right of the figure, upon which the letters *A*, *B*, etc., are written.

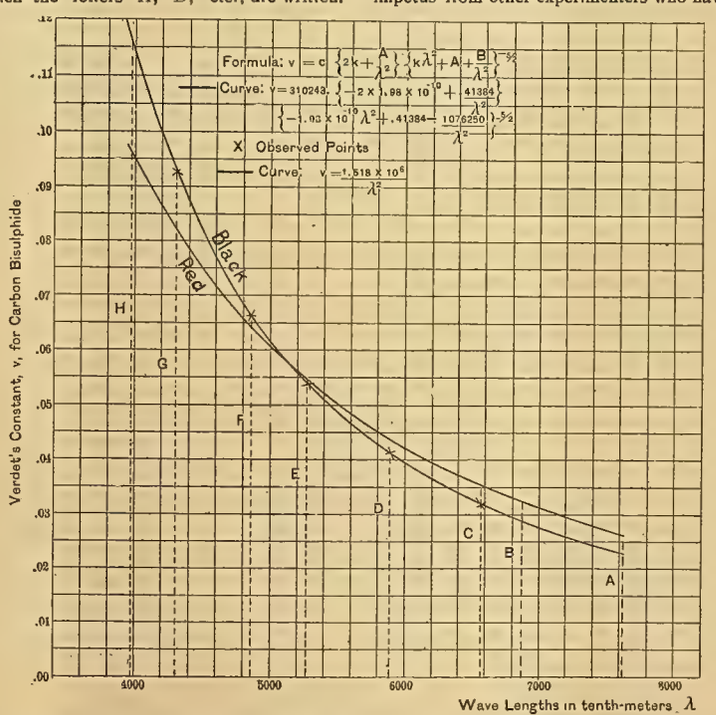


FIG. 5. A RELIABLE METHOD OF RECORDING VARIABLE CURRENT CURVES.

These letters show the positions of the various Fraunhoffer lines, and one parabola is drawn for each line. Each parabola then corresponds to one setting of the analyzer such that the dark band is found at these lines of the spectrum for zero current. The upper parabola is at the red end and the lower at the blue end of the spectrum. The axis of current is the base line of the diagram, and currents to the left of the vertical line are called negative, while those to the right are called positive. The axes of all the parabolas coincide with each other and with that of the current, and for a given quartz plate they all intersect this axis at the same point, so that taking different settings of the polarizer is equivalent to changing the parameter only of the parabola.

The interpretation of these results may be put as follows: If we have a spectrum in which the wave lengths are proportional to the distances along the spectrum (which is the case with Professor Rowland's arrangement of a concave grating), then the displacement of the dark band to one side or the other, due to the current, will be exactly according to the shape of these parabolas near the zero point, that is, near the vertical line lettered *A*, *B*, etc. Since it appears that each parabola at such a great distance from the origin is nearly a straight line, the displacement in such a spectrum will be nearly proportional to the current.

A noticeable feature, easily revealed by the graphical construction, is that in the red end of the spectrum, where the inclination of the parabola to the i axis is the greatest, the motion of the band will be the greatest for a given current.

Of course, it is understoood that this construction has to do with the relation between the wave length and current, and not between the displacement and current, unless the wave length and displacement are proportional. It does not apply, for instance, to the displacement in the spectrum of most prisms. In the prisms used the red rays were so crowded together that the motion as observed was nearly the same in the red as in the blue. The width of the band, however, is for this reason narrower in the red than in the blue, a consideration of considerable practical importance.

DESCRIPTION OF SOME OF THE APPARATUS.

The tube upon which the coil carrying the current was wound was a glass tube of 1.4 cm. internal, and 1.8 cm. external diameter, and 70.15 cm. long. The tube was filled with carbon bisulphide, which was confined in the the tube by means of two plane parallel plates of glass, each 1.3 cm. thick, fitted tightly upon the ground ends of the tube. Upon this tube was wound six layers of No. 18 double cotton copper magnet wire, occupying a length upon the tube of 61 5 cm. The wire was wound so that 100 turns occupied 12.7 cm. Thus the total number of turns, 2,900, is very large considering the size of wire.

The light used was sunlight reflected from the mirror of the heliostat.

The Nicol prisms are two fine specimens which were obtained by Dartmouth College at a time when larger specimens could be obtained than may now easily be found. The width of the slit does not need to be very narrow. A width of a quarter to half millimeter will do better than a narrower one, because more light is admitted to the photographic plate, and in passing through so many different substances even sunlight is rendered comparatively feeble by the time it strikes the photographic plate.

A further description of the apparatus is hardly deemed to be necessary, inasmuch as no claim is made to having obtained more than the most crude of first results, which may be the results attained by apparatus arranged in a comparatively poor manner for the end sought. Yet the results obtained seem to be so promising for the future that the subject is presented to you at this early date in the experiment in the hope that it may soon receive an impetus from other experimenters who have better facilities than those at my disposal, and thus become a fruitful source of extending our knowledge of instantaneous current flow in conductors.

The objections which most naturally suggest themselves against this method of taking current curves are, perhaps, the following: The photographic plate must move so quickly that the time of exposure of any one part of the plate is extremely short. To meet this demand the most sensitive plates that can be made should be used. The width of the band with any given plate depends largely upon the time of exposure. Then, too, a plate is to be desired that will photograph toward the red end of the spectrum as well as in the blue. The band does not possess very sharp outlines, but gradually shades off from dark to light.

These objections do not have so much weight, however, in cases where the general direction of the variation of the current is what is wanted more than any exact measurement of its amount, and in the majority of cases this is really what is wanted. Yet it cannot be said that in these preliminary experiments the band used was nearly as sharp as may be obtained.

Another objection of a different nature that seems difficult to avoid is the fact that the coil, which is wound upon the tube, must necessarily possess a small amount of self-induction. It may be said, however, that even though we are prohibited from measuring certain currents on account of this self-induction, we are always sure that we are measuring the exact current which is flowing through the coil.

A MORE EXACT EXPRESSION OF THE RELATION BETWEEN THE WAVE LENGTH AND VERDET'S CONSTANT.

The approximate relation between the wave length and Verdet's constant used above was that Verdet's constant varied inversely as the square of the wave length. It is considered of sufficient interest to inquire just how nearly this is an approximate formula.

By reference to equation (2) it is evident that if we only knew the relation between the index of refraction and the wave length, we might obtain the relation between the wave length and Verdet's constant in terms of these two quantities alone and constants.

Such a relation is afforded by Briot's formula, which is a modification and improvement upon the well-known formula of Cauchy. This is

$$1/n^2 = k\lambda^2 + A + B/\lambda^2 + C/\lambda^4, \qquad (14)$$

where n is the index of refraction corresponding to the wave length λ, and k, A, B, etc., are constants for the given substance. Assuming that all terms beyond B/λ^2 are negligible, we may differentiate with respect to λ and obtain the equation:

$$-\frac{\lambda}{n}\frac{dn}{d\lambda} = n^2\left(\frac{B}{\lambda^2} - k\lambda^2\right). \qquad (15)$$

Upon elimiuating B/λ^2 between (14) and (15) we obtain

$$-\frac{\lambda}{n}\frac{dn}{d\lambda} = 1 - 2kn^2\lambda^2 - Ak^2. \qquad (16)$$

Substituting in (2) the expression thus obtained, we have

$$v = c\,n^5\left(2k + \frac{A}{\lambda^2}\right). \qquad (17)$$

But by (14)

$$n^5 = \left(k\lambda^2 + A + \frac{B}{\lambda^2}\right)^{-\frac{5}{2}} \qquad (18)$$

Hence

$$v = c\,(2k + A/\lambda^2)\left(k\lambda^2 + A + \frac{B}{\lambda^2}\right)^{\frac{5}{2}} \qquad (19)$$

This formula represents to a high degree of accuracy the observed values of Verdet's constant for carbon bisulphide. It probably would for any other substances, but carbon bisulphide is the only one to which it has been applied by me. The constants k, A and B may be found by means of equation (14) and the observed values of the refractive index for known wave lengths. The values used are those observed by Messrs. Gladstone and Dale. (See Glazebrook's Physical Optics, page 243.)

Line of spectrum.		Index of refraction for Carbon Bisulphide.
A	7621	1.6142
B	6870	1.6207
C	6563	1.6240
D	5893	1.6333
E	5270	1.6465
F	4861	1.6584
G	4308	1.6836
H	3969	1.7090

These values give the red curve in Fig. 4. The lines *A*, *F*, and *H* were selected, and three simultaneous equations formed from (14), so that the resulting black curve should pass through these three observed points.

The values

$$k = -1.98 \times 10^{-10} \qquad (20)$$

$$A = .41384 \qquad (21)$$

$$B = 1076250. \qquad (22)$$

were obtained by the determinant solution of these three simultaneous equations. The resulting black curve may not appear to coincide very closely with the red, but it must be remembered that the origin of co-ordinates is a long distance below the paper, and the apparent differences are but a very small fraction of the whole. The unit is the tenth meter for wave lengths.

Having these contants they may now be substituted in (20) and c determined from the observed values of Verdet's constant. These observed values are:

Line of Spectrum.		Verdet's Constant for Carbon Bisulphide.
C	6563	0.0319′
D	5893	0.0415′
E	5270	0.0537′
F	4861	0.0667′
G	4308	0.0920′

The constant thus determined, where a minute is the unit of angle, gives

$$c = 310243 \qquad (23)$$

Using these constants for equation (19), we obtain the black curve in Fig. 5. The points marked × are the observed values and the calculated curve practically passes through them all.

The red curve in this diagram represents the approximate law that Verdet's constant is inversely as the square of the wave length, and the degree of the approximation may be observed.

The Chicopee Street Railway company at Chicopee, Mass., will organize with $100,000 capital stock to build an electric street railroad from Holyoke to Springfield. The directors are Charles C. Abbey of Chicopee, James E. Delaney of Holyoke, Selig Manilla of Springfield and others.

The Guadalajara Electric Light Installation, Utilizing the Juanacatlán Water Falls in Mexico.[1]

By Rafael M. de Arozarena.

Among the industrial enterprises taken up in Mexico by local capital, the plant for the supply of the electric light and power in the city of Guadalajara, Jalisco, is one of the most notable, not merely because of its magnitude with respect to the investment required, but also because the project necessitated the use of novel and special machinery, the source of supply being located 17 miles from the base of demand.

The problem was to install at the falls of Juanacatlán (the Niagara of Mexico) a hydraulic and electric plant which should be capable of supplying in the city of Guadalajara —distant 17 miles—sufficient electric energy to operate some 950 horse power in the form of light, divided up as follows: Seven thousand five hundred incandescent lights of 16 candle power each and 200 arc lights of 2,000 candle power each.

After careful consideration and study, the plans were projected and the machinery ordered from the following well-known houses: The electric machinery and material from the Thomson-Houston International Electric company of Boston, Mass.; the turbines and piping from James Leffel & Co. of Springfield, O.; the valves from the Ludlow Valve Manufacturing company; the countershaft, clutches, pulleys and bearings from the Hill Clutch company of Cleveland, O., and the iron poles for carrying the wire on the main line from the falls to the city—a distance of 16 miles—as well as for the wires in the city, from the Reading Iron company of Reading, Pa.

The falls of Juanacatlán are on the Grande river and situated some 17 miles (28 kilometers) southeast from the city of Guadalajara. The whole volume of the river falls at this point some 58 feet in a perpendicular line, with the shores above the falls sloping gently to the stream. Below the falls the shores on both sides slope at almost at an angle of 45°, leaving but little room at the bottom upon which a building could be erected, for which reason the building was projected of three stories, as shown by the section in Fig. 1.

The work above the falls was simple and of easy execution, for, the river being very wide at this point, it is shallow, and a masonry wall some 3 feet high was built, running across the river for two-thirds of its width and at an angle of 45° to the line of the falls, the object of which was to carry the greater part of the water in the river to a given point on its left bank directly at the falls; then a raceway was formed 14 feet high by 14 feet wide, from which the conduit pipe, seven feet in diameter, carried the water down to the turbines. This conduit pipe is made of wrought iron sheets ¼ inch in diameter, riveted together, no flanges being used. At the head of the pipe is located a vent pipe to prevent the pipe from collapsing when the wooden gate, which is located at its entrance, is closed. The pipe, to conform to the nature of the fall at this point, has two elbows of 90° and one of 45°, from which on a horizontal line it connects the three turbines together, reducing its diameter from 7 to 6 feet between the first and second turbine, and from 6 to 5 feet between the second and third turbine, Fig. 2. Directly in line with the piping are located the three horizontal double Leffel turbines, and between the turbines and the conduit pipe in the connecting pipes, which are 4 feet 6 inches in diameter, are located Ludlow straightway gate valves, which are opened and shut by geared hand wheels, thereby permitting the water to be closed off from each or any of the turbines without having to stop the others.

The turbines, located on the first floor of the building, are horizontal double wheels, placed in one case; both wheels are connected directly on the same shaft, which extends out from the case on both sides, and has at each end a sheave pulley for transmitting the power, Fig. 2. Each turbine is 20 inches in diameter, and has its independent draft tube; and as the river is known to rise in the rainy season from one to two meters, the turbines were placed 16 feet above the bed of the river, with draft tubes, all 10 feet long, discharging into a well 4 inches deep (which is the average depth of the river in the dry season), making the distance from the center of the turbines to the surface of constant water in the tailrace exactly 12 inches. This mode of setting turbines with draft tubes has given the writer excellent results here in Mexico.

The power of each set of turbines is 550 horse power, making a total of 1,650 horse power. The power is transmitted from the turbines to a countershaft placed in the second floor of the building. A rope driver is used, of endless manilla, plumbago, tallow-laid rope, 1 inch in diameter, using an idler pulley on a stress car, with weight. Each pulley has 15 grooves to receive the 15 strands of rope.

The pulleys on the turbines are 42 inches in diameter and connect with clutch pulleys on the countershaft of 84 inches diameter, giving a speed of 6,594 feet per minute to the rope. This driver, when the speed does not exceed 7,500 feet per minute, by using sheaves at least 40 times the diameter of the rope, the writer has found to be very satisfactory, and on account of its duration much cheaper than belt drivers, especially for damp places.

In Orizaba, over two years ago, the writer used this driver for transmitting 188 horse power, for electric light work; the rope, which to-day shows no signs of wear, is the same one which has been used from the start, and the plant has run on an average 11 hours every night, without any interruption. Great care must be taken, however, not to put too much weight on the stress car which carries the idler pulley.

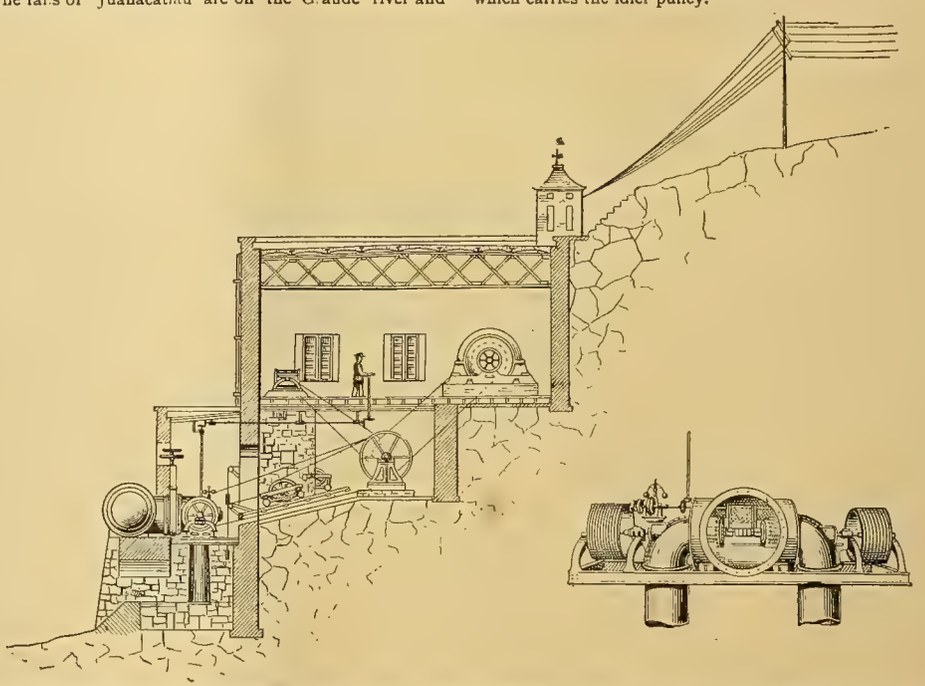


FIG. 1. THE GUADALAJARA ELECTRIC LIGHT INSTALLATION, UTILIZING THE JUANACATLAN WATER FALLS IN MEXICO.

Arc Lighting Dynamos.—For furnishing current to operate the arc lights, the familiar Thomson-Houston "M. D." dynamos were employed. They have capacity each for 50 arc lights of 2,000 candle power, or, in other words, a rated output of 25 kilowatts. The current strength is 10 amperes and consequently the maximum voltage 2,500.

The dynamos weigh 3 tons each, require floor space of about 15 square feet, a belt speed of 3,863 feet per minute, with a consumption of nearly 50 horse power under full load. Four such dynamos, Fig. 3, are in use, operated two in series to avoid multiplicity of wire. Thus, for a total capacity of 200 lights, only two circuits leave the generating station. Each dynamo is supplied with the usual ingenious and efficient "automatic regulator and controller," without which it would be well-nigh impossible to fulfill the condition. With such, however, lamps may be lighted or extinguished without the necessity of paying attention to the dynamo.

Arc Circuits.—The current is conveyed from the dynamos by means of highly insulated copper wires to a slate switchboard arranged for any desired combination of machines; from here through current indicators to the lightning arresters, from which the wires are led to the pole line. The pressure utilized being rather above the safe limit, the insulation of the circuit is augmented by fastening the wires upon oil insulators, mounted upon wooden cross-arms. The construction of these insulators is such that leakage is practically prevented, as, in order to escape by leakage, it would be necessary for the electricity not only to overcome the wire insulation, but also to pass through two strata of oil, the insulating qualities of which are well known.

In the city of Guadalajara these circuits are led to a central distributing station, in which is placed a duplicate plant of lightning arresters, switchboards and testing instruments. It is from this station that the lights are directly controlled.

Arc Lamps.—Standard double carbon arc lamps are used throughout the city. They are suspended from steel cables, stretched from corner to corner, supported by house structures arranged with pulleys and cables so that the renewal of carbons may be readily attended to.

1. Read before the American Society of Civil Engineers.

Incandescent Dynamo.—As but one dynamo was desired for this installation, one of special construction was supplied. It is of the alternating current type, has 40 pole pieces, and yields approximately 350 amperes at 1,000 volts, or 350 kilowatts. The dynamo, Fig. 3, weighs between 30 and 40 tons, requires a floor space of 216 square feet and a belt speed of 5,024 feet per minute, consuming, under full load, some 750 horse power. The armature is run at the low speed of but 300 revolutions per minute, and the shaft, which is 9 inches in diameter, is furnished with a 60 inch pulley, having 28 grooves for 1¼ inch rope, as this dynamo is driven from the countershaft with a rope driver the same as between the turbines and the countershaft. The 40 pole pieces forming the field magnets are excited by means of a separate exciter, known as "D 5," and having an output of 5 kilowatts at 125 volts.

Various indicating instruments are installed, enabling the operator to tell at a glance what load is upon either machine and at what pressure the dynamos are operating. To convey with moderate loss so great a current as 350 amperes over a distance of 17 miles would require a copper wire having a sectional area of about 4 square inches. Such a conducter could not be used, for practical reasons, to say nothing of the expense, which would be itself prohibitive. As the proper section of copper wire varies directly with the current it is necessary to carry, it is obvious that, in order to transmit such power over a wire of moderate size, the quantity of current must be reduced. Without changing the quantity of wire this may

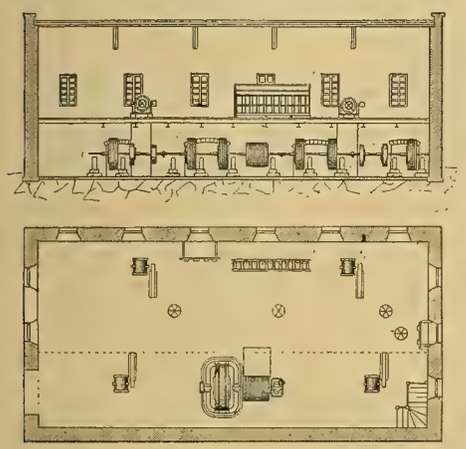


FIG. 3. THE GUADALAJARA ELECTRIC LIGHT INSTALLATION, UTILIZING THE JUANACATLAN WATER FALLS IN MEXICO.

be done by increasing the voltage, which, accordingly, was raised to a maximum of 5,000, thus reducing the current to about 70 amperes, and the size of the wire to one having a sectional area of .1662 inch.

Step-up Transformers.—To so increase the voltage from 1,000 to 5,000, a bank of 10 step-up transformers was installed These are built upon the lines of the type "F" oil transformer manufactured by the General Electric company. They transform the energy of the dynamo at an efficiency of about 98 per cent., delivering to the line, therefore, 98 per cent of the energy supplied them and at five times the pressure. The transformers are so designed as to be filled with oil, the insulating qualities of which are very high, thereby increasing the insulation resistance of the transformer, rendering it less subject to damage from lightning discharges, and, indeed, restoring the insulation, should it be destroyed by means of a stroke of lightning. The transformers are banked or operated in multiple. They have a capacity of 30 kilowatts each; weigh approximately 1,300 pounds, each requiring 12 cubic feet of space. They are protected by a simple but effective system of circuit breakers and fuse connections, and the current passing from them is carried through a special lightning arrester designed to protect circuits of extraordinarily high potential.

Main Circuit.—The cross-arms, pins and insulators used in connection with the alternating circuit are precisely the same as those described under the heading "Arc Circuits."

Step-down Transformers.—The high potential incandescent line carried to the central station in the city of Guadalajara is passed through lightning arresters and safety devices, as described above, to the bank to step-down transformers, which reduces the pressure to 1,000 volts, at which potential it is carried through the streets of Guadalajara as in ordinary installations. In the Guadalajara central station switchboards are installed, enabling any combination of lights and circuits to be made, without attention to the dynamos at the point of generation. The number of lights in operation, the physical conditions of the circuits, and indeed the conditions of the dynamos at the generating station, can all be determined in Guadalajara. Telephonic communication is established between the two stations, enabling those in charge to give their directions promptly. An exterior view of the generating station is given in Fig. 4.

As a further protection against lightning, which in the state of Jalisco is very severe, iron poles have been used, each surmounted by a pointed lightning arrester rising some 3 feet above the top of the pole, or, say, 5 feet from the highest curent conveying wire. These arresters are, of course, mechanically connected to the iron poles, besides which they are joined to each other by means of an iron wire. This is considered the most effective protection possible, as it produces an artificial "earth" above the wires conveying the electrical current.

Metropolitan Elevated Electric Railway, Chicago.

The most important electrical contract that has been closed in the United States for a year was awarded last week by the Metropolitan West Side Elevated Railroad company of Chicago. As the readers of the WESTERN ELECTRICIAN are aware, this company some time ago decided to operate its elevated railway by electrically transmitted power, being largely influenced by the conspicuous success of the Intramural railway at the World's Fair. Careful estimates were made of the relative expense of installing and operating steam and electric locomotives, with the result that a net saving of some $200,000 a year was figured in favor of the electrical system. The economy is effected by the use of cheaper fuel in the power house than is permissible under the boilers of the steam locomotives, and by the lessening of the labor bill, due to the fact that no high priced enginemen and firemen are needed on the trains. With this in view and with the object lesson afforded by the elevated electric railway in operation at Jackson Park last summer, the directors of the Metropolitan company came to the conclusion to employ electrically transmitted power. Bids for all or a portion of the electrical equipment were furnished by the General Electric company, Schenectady, N. Y.; Westinghouse Electric & Manufacturing company, Pittsburg, Pa.; Siemens & Halske Electric company of America, Chicago; Walker Manufacturing company, Cleveland, O., and Electric Construction company, London. Owing to the tariff on electrical machinery, the English company's bid was much higher than that of any American bidder. After due consideration the contract for the entire electrical equipment was, on June 22d, awarded to the General Electric company. The contract price is not known, of course, outside of the two companies immediately interested, but it is supposed to be in the neighborhood of $200,000 or $225,000. The men most active in securing the contract for the General company were Capt. Eugene Griffin and W. H. Knight of the main office and T. P. Bailey of Chicago.

The contract covers the generators, switchboard, motors, line and construction work. Four generators are provided—two of 1,500 kilowatts each, to be operated at 75 revolutions per minute, and two 800 kilowatt machines designed for 100 revolutions. Thus the total initial capacity of the station will be 4,600 kilowatts, or over 6,000 horse power. The generators will all be directly coupled to the engines, but the type and make of the latter have not yet been announced.

At the start the road will be operated on a plan calling for 55 three-car trains and consequently demanding the same number of motor cars. Each motor car will be supplied with two 100 horse power motors—one on each truck—and 110 motors will, therefore, be necessary. Series parallel controllers, improved somewhat over the type in use on the Intramural road, will be used, and the current will be transmitted to the motors by a third rail at 500 volts' pressure. In general, the system of operation in use at the World's Fair will be adopted, but many details, such as the position of the motorman, and the question of open and closed cars, remain to be settled. The apparatus will all be of the standard railway type of the General Electric company.

The management of the road is anxious to run trains early in the fall, and it is not unlikely that some temporary arrangement for obtaining power may be made if the generators are not ready for operation by that time. The Metropolitan company is already in possession of the plant of the old Throop street municipal lighting station,

FIG. 4. THE GUADALAJARA ELECTRIC LIGHT INSTALLATION, UTILIZING THE JUANACATLAN WATER FALLS IN MEXICO.

which it purchased from the city for its right-of-way, and it is possible that these engines may be utilized for a short time to drive 500 volt generators of ordinary size obtained size from the stock of the General Electric company.

The Metropolitan elevated railway will be the first permanent all-elevated road in the United States to be operated by electrically transmitted power. The main line is about five miles long, running due west between Van Buren and Congress streets, with a northern branch at Paulina street. The structure and stations are nearly completed. The location of the power house has not yet been made public.

Permit to String Wires in Chicago Revoked.

The permit granted a short time ago to the Mutual Electric Light & Fuel company, Chicago, to string wires in accordance with the terms of its ordinance, was revoked last week. James Walsh, of the Calumet Electric company, told the corporation counsel that the Mutual Electric Power & Light company did not intend to construct a power plant, at least not at present, but proposed to connect its wires with the power house of the Hyde Park Electric Light company. Objection was made to this arrangement, as it would practically give to the Hyde Park Electric Light company access to the territory withheld from it by ordinance. It was also pointed out that the intention of the council, when it passed the ordinance, and of the mayor when he vetoed the original draft and submitted the amendments which were adopted, was to afford competition in the southern district of the city. The ordinance also provided that the company construct within one year a plant to cost not less than $40,000 and that it should have a capacity of furnishing not less than 350 arc lights. In the event of the company not complying with these conditions the ordinance was to become a dead letter. On these representations the law department recommended the revocation of the permit.

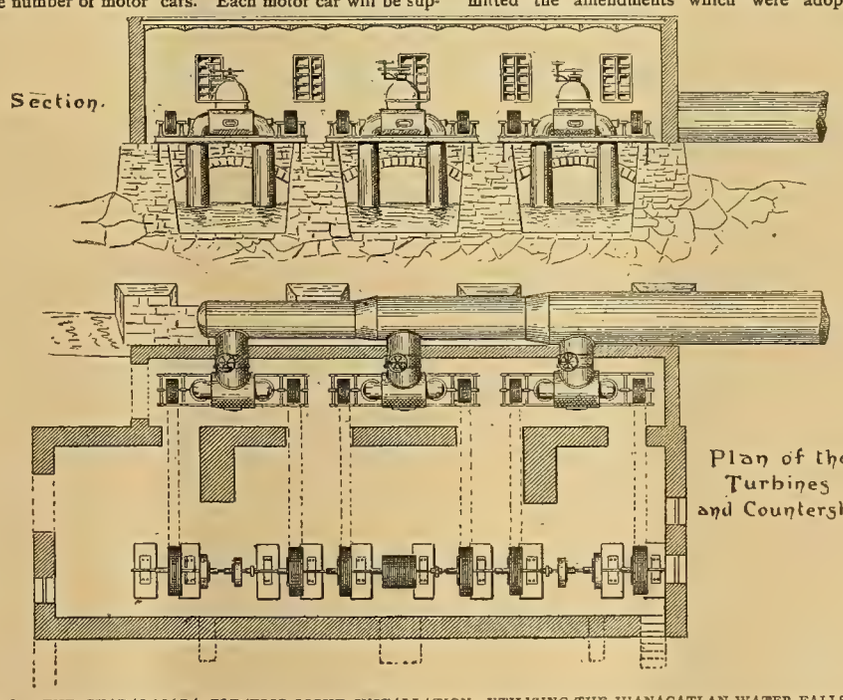


FIG. 2. THE GUADALAJARA ELECTRIC LIGHT INSTALLATION, UTILIZING THE JUANACATLAN WATER FALLS IN MEXICO.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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PREPARATIONS for the Northwestern Electrical association's convention at St. Paul next month are now in progress, and they indicate that interest in this organization is increasing throughout the West and Northwest. It is generally admitted that a powerful organization will eventually grow out of this association. There is every reason to believe that the attendance this year will be greater than at the last convention, which was, by the way, one of the most successful meetings of an electrical organization in this country. It is a noticeable fact that in many respects the new organization has departed from the lines followed by the older associations in that it adheres strictly to the business in hand, devotes the entire time to the reading and discussion of papers and an exchange of views on subjects of practical value to the members. These meetings are not regarded by the members as holidays, but as matters of much consequence in a business sense. The list of papers contributed to the Milwaukee gathering would compare favorably with the programme provided by any of the older organizations. The Northwestern association has started on the right line; it should be encouraged, as it is deserving of success.

POWER transmission is a simple problem in this country as compared with the difficulties encountered in Mexico and Central and South American states, yet in these countries several important installations have been made, principally by American electrical companies. An interesting description of an electric plant at Gaudalajara is presented elsewhere in this issue. Water power is utilized, the falls of Juanacatlán driving the generators which supply the current for light and power in the city seventeen miles distant. It is an interesting fact that the machinery for the electrical and hydraulic plant was of American manufacture. The enterprise is one of considerable magnitude and possesses many interesting features which should be studied with care by those engaged in similar undertakings.

GERMAN electrical construction companies are much interested just now in the proposed regulations for wiring which have been prepared under the direction of the insurance companies. Hitherto little attention has been given to the rules of the underwriters, the principal companies following specifications prepared by their own experts. About two years ago the Society of German Insurance Companies decided to establish regulations which would secure uniformity of practice and raise the general standard of work. Experts were employed to investigate the subject, and it is their report that is now under discussion. The regulations are said to be based on the recommendations made by Dr. Oscar May to the Electrical Congress at Frankfort in 1891, with some modifications. Before the report received the approval of the society several large electrical concerns were asked for their views, and it is said that the proposed rules were freely criticised. Some of the companies have openly expressed their disapproval of the scheme, and signified their intention to disregard it entirely. At the present time there is a movement on foot to secure a conference of representatives of the insurance and electrical companies with the hope that an agreement may be reached.

In this country the question of adopting rules for electrical installations proved to be one of the most difficult problems that confronted the electrical people. Much of the construction work in the early days of electric lighting was poorly done, and the losses that naturally resulted made the insurance men look with suspicion or distrust upon every suggestion made by the electrical companies. This conflict continued until representatives of both interests began to work in harmony. Then a better feeling prevailed and the work progressed rapidly. The National Electric Light association took an active part in the solution of this problem, and to the efforts of the committee representing that body the success of the conference work is largely due. No doubt the same policy will ultimately be adopted in Germany. It is certainly to the interest of all concerned that an amicable agreement be reached.

A RECENT decision of the Court of Appeals of Kentucky, in the case of the Louisville Bagging company against the Central Passenger Railway company, is of interest as determining the rights of street railways in the United States. The court held that the trolley system of operating street railway cars, when properly adjusted and supervised, is not much, if any, more dangerous than horse power and much less so than steam power applied in the same way, also that while street railway cars operated by electricity go at a greater speed, "they are more comfortable, easier controlled than horse cars, and do not really obstruct the streets more or interfere unreasonably with business transacted upon them." In view of the benefit and convenience to the public of electric cars of the overhead trolley system and the comparatively little inconvenience or danger they are to individuals, the court decided that it would be going beyond its province, and contrary to the weight of judicial authority, to enjoin or limit the use of electric cars. This decision is a popular one and is indicative of the more generous feeling which is being exhibited toward electrical railways, as their operation becomes more generally understood. The judge in this case took occasion to compare the different systems of street railway traction, and in his opinion spoke of the trolley system as the only one which is practicable at the present time.

Another recent decision, rendered in Trenton, N. J., by Chancellor McGill, is equally important in relation to this subject. The case before the court was that of the Camden, Gloucester & Woodbury Electric Railway company and the West Jersey Railroad company. The latter company secured a temporary injunction against the electric company, restraining it from crossing the former's tracks and erecting poles upon its land. The court dissolved the injunction and said that electric roads are but a modified form of the horse car system and have the same rights and are under no obligations to pay extra compensation for the erection of poles upon abutting properties; that in the matter of speed and danger, the municipalities have power of regulation, and that the placing of an electric pole immediately within the curb on the sidewalk is not an additional burden upon the land for which compensation may be required.

THE awarding of the contract by which the electrical power equipment of the Metropolitan elevated railway in Chicago becomes an assured fact is one of the most important electrical events since World's Fair time. Not only is the contract itself of the first magnitude, and particularly encouraging in coming when the effects of the business depression are still with us, but it promises to mark the opening of an era of new business—that of equipping elevated railroads in large American cities with apparatus for the generation, transmission and utilization of electrical power. It will not be long before another contract of similar character will be closed in Chicago, and the directors of other elevated railway companies are very carefully considering the question of availing themselves of the pronounced economy in operation obtainable by the use of electrically transmitted power. Not only that, but it is fair to assume that the reduced cost of operation will render it possible to construct and operate at a profit elevated railways in several of the larger cities where none now exist. Experience has demonstrated—particularly in Chicago—that, with strong competition from well established surface lines, it is often difficult for the managers of steam elevated systems to show a profit when burning anthracite coal at $4 or more a ton on the locomotives and employing high-priced enginemen and firemen. By electrically transmitting the power of cheap bituminous coal burned in the power house, it is possible to at once cut the coal bill in half and also to materially reduce the labor expense. This is the enticing possibility held out to existing and prospective elevated railway companies, and the outlook, therefore, for an increasing demand for generators and motors for this use is very encouraging. It is probable, also, that the cars of elevated electric railways will be electrically lighted, so that a considerable quantity of lamps and lighting accessories will be needed in this quarter.

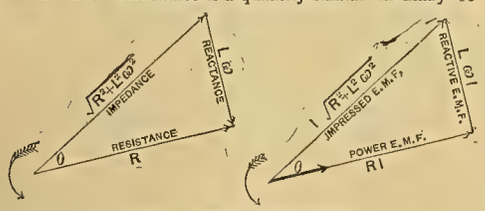
For this hopeful state of affairs the success of the Intramural railway at the World's Fair is largely responsible. Former experiments in the electrical operation of elevated railroads in the United States had been disappointing to the electrical fraternity. But with added experience, and particularly by designing generators and motors that could only err on the safe side in the point of capacity—thereby avoiding a mistake too frequently made in early American electrical construction—the road at Jackson Park was made to demonstrate to the world that there was no difficulty in constructing elevated railways that could be operated under the most exacting conditions with entire success. It is true that the road was not subjected to the test of operation amid the snow and ice of winter, but every other trying condition—heavy loads, steep grades, sharp curves and frequent stoppages—was present, and it cannot be doubted that the road could have been operated with almost equal facility in severe weather. The exposition abounded with object lessons of the utility of electricity, but none was more important than the Intramural railway, and it is entirely within the bounds of probability that the future electrical engineer will date a revolution in elevated railroad methods from the World's Fair. The economy of the electrical system appealed to the pocket-book, while a practical example showed its efficiency and reliability. The combination presents a very effective argument, and one that holds fair promise of extensive demonstration throughout the country.

It would be hardly fair to dismiss the consideration of this very interesting subject without mention of the name of B. J. Arnold. To Mr. Arnold, as the designer of the Intramural power plant and as the engineer who has devoted at least as much study to this problem as any man in the country, the thanks of the electrical fraternity are due for valuable assistance in opening up this new field.

Reactance.[1]

By Charles Proteus Steinmetz and Frederick Bedell.

The term "reactance," which has been used and advocated by the writers and others and which has been officially adopted at our suggestion by the American Institute of Electrical Engineers at its Philadelphia meeting, is one which assumes particular importance now that the term "inductance" is defined as synonymous with the "coefficient of self-induction," usually symbolized by the letter "L". Reactance is a quantity similar in many respects to resistance, but the electromotive force used in overcoming reactance consumes no power, for it is at right angles to the current.



FIGS. 1 AND 2. REACTANCE.

The impressed electromotive force in an alternating current circuit may be divided into two components: First, the power electromotive force in the direction of the current, and, second, the reactive electromotive force in quadrature with the current to overcome the reactance. The reactive electromotive force is the product of the current and the reactance. The reactance is, accordingly, equal to the component of the impressed electromotive force at right angles to the current, divided by the current. Reactance is measured in ohms.

The reactive electromotive force in the circuit may be due to self or mutual induction, to capacity or to some outside counter electromotive force produced by a motor or other device. In general, in any alternating current circuit,

Impressed E. M. F.

$$= \sqrt{\text{Power E. M. F.}^2 + \text{Reactive E. M. F.}^2};$$

that is, the impressed electromotive force is the vector sum of the electromotive force which transmits power and the reactive electromotive force.

Reactance tends to cause a phase difference between current and electromotive force. If θ represents this angle of phase, we have the relation,

$$\tan\theta = -\frac{\text{reactance}}{\text{resistance}}$$

When θ is negative, the current lags behind the electromotive force; when θ is positive, the current is in advance of the electromotive force. The expression for the instantaneous value of the current may be written,

$$i = I \sin(\omega t + \theta),$$

or

$$i = \frac{\text{Impressed E. M. F.}}{\text{Impedance}} \sin\left\{\omega t - \text{arc tan}\frac{\text{reactance}}{\text{resistance}}\right\},$$

A few illustrations of particular cases will make the use of the term reactance more clear.

Circuits Containing Resistance and Inductance.—In a simple circuit containing resistance and inductance, the reactance is equal to $L\omega$; that is, it is 2π times the product of the inductance and frequency. The impedance being the vector sum of the resistance and reactance, is

$$\text{Impedance} = \sqrt{R^2 + L^2\omega^2},$$

where $\omega = 2\pi \times$ frequency. In this case all the power is used in overcoming resistance, and the power electromotive force is equal to the ohmic electromotive force RI. The reactive electromotive force is equal to the inductive electromotive force $L\omega I$; hence

Impressed E. M. F.

$$= \sqrt{\text{Power E. M. F.}^2 + \text{Reactive E. M. F}^2};$$ or

Impressed E. M. F.

$$= \sqrt{\text{Ohmic E. M. F.}^2 + \text{Inductive E. M. F.}^2}.$$

The impressed electromotive force in this case is the vector sum of the electromotive forces necessary to overcome resistance and inductance.

A consideration of Figs. 1 and 2 (in which positive direction is counter clockwise) will show that the reactance and reactive electromotive force are positive in the case of a circuit containing inductance. The impressed electromotive force, which is the sum of the two, is therefore in advance of the current, which is in the same direction as the power or ohmic electromotive force. The current is indicated by a closed arrow in the figures. The same, however, may be otherwise expressed if we take the impressed electromotive force as our direction of reference, by saying that the current lags behind the electromotive force by the angle θ, which angle is negative, therefore, for circuits with inductance according to the relation

$$\tan\theta = -\frac{\text{reactance}}{\text{resistance}} = -\frac{L\omega}{R}$$

The value of the current at any instant is given by the equation

$$i = \frac{E}{\sqrt{R^2 + L^2\omega^2}} \sin\left(\omega t - \text{arc tan}\frac{L\omega}{R}\right)$$

Circuits Containing Resistance and Capacity.—In such circuits the reactance is equal to $-\frac{1}{C\omega}$, where C, capacity, and $\omega = 2\pi \times$ frequency, that is, it is negative. The reactive electromotive force is also negative, being equal to $-\frac{I}{C\omega}$. This negative reactance gives a positive value to the angle θ, and the current is accordingly in advance of the electromotive force. We have then

$$\text{Impedance} = \sqrt{R^2 + \frac{1}{C^2\omega^2}}$$

and

$$\tan\theta = -\frac{\text{reactance}}{\text{resistance}} = +\frac{1}{CR\omega}$$

similar to the corresponding equations above. The instantaneous value of the current is given by the equation

$$i = \frac{E}{\sqrt{R^2 + \frac{1}{C^2\omega^2}}} \sin\left(\omega t + \text{arc tan}\frac{1}{CR\omega}\right)$$

These relations are shown in Figs. 3 and 4.

Circuits Containing Resistance, Inductance and Capacity.—In a circuit containing inductance and capacity the reactive electromotive force is the sum of the inductive electromotive force and the condenser electromotive force; that is,

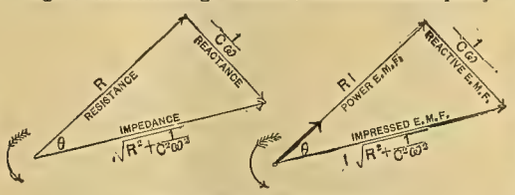
$L\omega I - \frac{I}{C\omega}$. The reactance is similarly the sum of two terms, $L\omega - \frac{1}{C\omega}$; thus, the reactance is positive or negative, according to whether the inductive electromotive force is greater or less than the condenser electromotive force. Whether the current is behind or ahead of the impressed electromotive force depends upon the same condition, for

$$\tan\theta = -\frac{\text{reactance}}{\text{resistance}} = \frac{1}{CR\omega} - \frac{L\omega}{R}.$$

The value of the current at any instant is

$$i = \frac{E}{\sqrt{R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}} \sin\left\{\omega t + \text{arc tan}\left(\frac{1}{CR\omega} - \frac{L\omega}{R}\right)\right\}.$$

The diagrams in Figs. 5 and 6 illustrate the case of a single circuit containing resistance, inductance and capacity.



FIGS. 3 AND 4. REACTANCE.

In the case here represented, the condenser electromotive force is greater than the inductive electromotive force, and the current is therefore in advance.

Circuits Containing Mutual Induction.—To further exemplify the use of the term reactance, let us consider a circuit containing a transformer. Beside the electromotive forces already discussed, we must consider the back electromotive force due to the influence of the secondary upon the primary circuit. This may be resolved into two components, one in the same direction as the current, and the other in quadrature with it, which will form part of the power electromotive and reactive electromotive forces, respectively. The electromotive force introduced by a motor is treated in the same way.

These illustrations will suffice to show the method by which any electromotive force in a circuit is resolved into two components, one in the direction of the current, which therefore transmits power, and the other at right angles to the current, which represents no power, but simply overcomes the reactance.

It is to be borne in mind that the terms here given may be used in all alternating current circuits, whether the current is harmonic or not; for, when the current is not strictly harmonic, we may consider it equivalent to an harmonic current. The equivalent harmonic current and equivalent harmonic electromotive force have the same square root of mean square values as the actual current and electromotive force, and have such relative phase positions that the same power is transmitted.

[1] American Institute of Electrical Engineers, Philadelphia, May 18, 1894.

Street Railway Interests in Ottawa, Ont.

The *Evening Journal*, Ottawa, Ont., devoted considerable space recently to the history of the street railway interests. Ottawa is one of the cities which thoroughly appreciates the advantage of electric traction. It is interesting to note that when the road began operations only six motor cars were owned by the company. Now the rolling stock consists of 22 open motor cars, 31 closed motor cars, four trailers, three postal cars and five sweepers, a total of sixty-five cars in all. Twenty-two miles of single track has been laid since 1891. The company, beside its rolling stock, owns two brick car sheds and offices on Albert street, and one of the finest water powers and power stations in America. The power house at the Chaudiere is fitted out with duplicate sets of dynamos and water wheels, the second sets being for use in case of accident. The electric horse power available at the power house is 1,700. A bill to amalgamate the Ottawa City Passenger Railway company and Electric Railway company has passed its final reading before the Dominion Parliament. The members of the firm of Ahearn & Soper, the Canadian representatives of the Westinghouse company, are connected with both street railway companies.

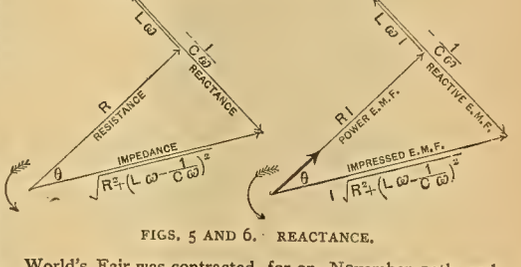
Electrical Features of the Midwinter Fair.

The lighting of the California Midwinter Exposition is noteworthy, not so much for any great novelty which has been introduced as for the success which has crowned the efforts of the management in overcoming difficulties which at one period, taking into account the limited time at disposal, seemed to be well-nigh insuperable. Following so speedily upon the closing of the World's Fair at Chicago, where about every appliance known to the electric world was exhibited, it could not be expected that novelties of application would be found at San Francisco.

The Western Electric, General Electric, Fort Wayne and Standard companies have contributed toward making this part of the exposition a success. One feature of the fair which deserves remark is the fact that the engines for driving the lighting dynamos have been almost wholly supplied by the engine builders of San Francisco. There was shown an indisposition at the initiation of the scheme by the most prominent engine builders of the city to give support either financially, or in any other way, to the exposition, unless the engine power required was supplied solely by makers on the coast. The time being very limited, this condition introduced difficulties which would not otherwise have had to be met. Any delay being fatal to the successful lighting of the exposition, the finance committee issued invitations to all the engine builders of San Francisco to state what they were in a position to supply for the purpose in a given time. The addition of annexes to the main buildings and of new concessions required that the space occupied by the power plant should be greatly increased, and the original estimate of 1,000 horse power for illumination was increased to 2,500 horse power. The installation and operation of the mechanical engineering plant was placed in the hands of Past-assistant Engineer A. M. Hunt of the Navy Department, to whose efforts is largely due the successful carrying out of the work. His energy inspired the local engine-builders with confidence, and, as stated by Lieut. W. F. C. Hasson, the chief of the electrical department, "A fair proportion of the promises made by them were ratified. The representatives of eastern companies furnished a number of high-speed engines suitable for the operation of arc light machines. The exposition, however, was still short seven hundred and fifty horse power of engines. The scrap heaps of San Francisco were ransacked, and work begun on putting two large engines in working order to meet the now imperative demand."

The electric tower in the center of the fair has proved successful and distinctive feature of the exposition. It has been lighted by the Western Electric company, and, considering the number of incandescent lamps employed, which was necessarily limited to 3,500 on the score of economy (the Western Electric company having orginally estimated that 8,000 would be necessary for a successful illumination), the effect was very brilliant and beautiful. The changing patterns and colors of the lamp designs, varying the series of attractive combinations, add very much to the effect. This changing of the designs of illumination, combined with the use made of the great searchlight on the top of the platform, forms a notable feature. The searchlight is the largest of those exhibited by the General Electric company at the World's Fair. It stands at an elevation of 272 feet.

The removal of one of the electric fountains from the World's Fair was contracted for on November 10th, and the General Electric company gave the use free of the dynamos necessary for operating the fountain and searchlight, as well as eight arc light machines and four hundred lamps now lighting the roadways and concessions, a direct current dynamo of 2,500 lights capacity used for the cornice lights and motor service, and a large alternator. This company also undertook to wire the main buildings for exterior lights and supply a railway generator for the lighting, which necessitated the adoption of a series system of connecting the lamps. This was accepted on account of its permitting more economic wiring, and proved a success.



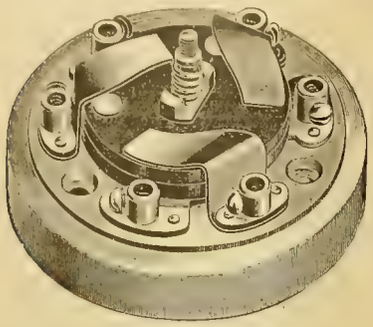
FIGS. 5 AND 6. REACTANCE.

The Fort Wayne company gave the free use of an alternating current machine of a capacity of 2,500 lights, which furnishes light for the festival hall, administration building and exposition offices generally.

The Standard Electric company furnishes four arc machines for lighting the mechanical arts and agricultural buildings.

The Western Electric company, beside the large generator for lighting the tower and some small machines for supplying current for motor service, furnishes the arc lamps and machines necessary for lighting the manufactures building.

The question of fuel for the power plant was solved by



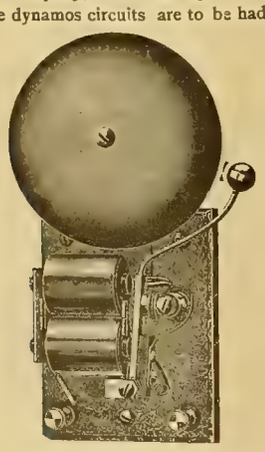
GIBBS TRIPLE POLE SWITCH.

Mr. Bart, the president of the Union Oil company of California, making an advantageous proposition for the supply of oil fuel, and thus, as at the World's Fair, the smoke and dust which the use of coal would have involved were avoided, and the boilers, supplied by the Heine Boiler company, are an interesting feature of the exposition. Four of these boilers had been in use at the World's Fair, with a capacity of 1,500 horse power, and owing to the failure of another company to have its boilers ready in time, the Heine company agreed to supply additional boilers of 1,500 horse power capacity on advantageous terms. A pair of crossed shovels painted white like the boilers and tied together with a red ribbon hangs between two of the boilers to emphasize the fact that the adoption of oil as fuel rendered unnecessary the use of labor for firing and kept everything clean and unsullied by smoke and dirt.

In the mining building there are models of the underground workings of the Standard Consolidated Mining company and the Bulwer Consolidated Mining company, showing the position of these mines, about which there was an important lawsuit several years ago, and photographic views of the Standard company's electric plant (a 12½ mile transmission) and a model of the pole line.

New Bell for Dynamo Circuits.

A new bell to work on circuits of from 50 to 500 volts, either direct or alternating, and without external resistance, is being placed on the market by the Electric Bell & Resistance company, Newark, N. J. These bells can be used where dynamos circuits are to be had. By winding a new high resistance conductor on the outside of the magnet coils, and connecting it in the manner adopted in this device there is no inductive spark at the armature contacts. Among the advantages claimed for this bell, in addition to avoiding the use of batteries, is the saving in cost of wiring, as in most cases it is only necessary to wire the bell circuits with one wire instead of two. This is accomplished by connecting the push button to the nearest service wire and running a single wire to the bell, and thence to the nearest service wire from that point. The bells are wired the same as ordinary lamps, and have cut-outs in circuit, and with this method the number of wires as well as trouble from defective wiring is diminished. The bells are mounted on a marbleized slate base, which insures perfect insulation and presents a superior appearance.



NEW BELL FOR DYNAMO CIRCUITS.

The company is placing on the market a 500 volt alarm bell for trolley cars, which has no external resistance.

Gibbs Triple Pole Switch.

The accompanying illustration represents a new three-pole snap switch recently designed by the Perkins Electric Switch Manufacturing company, Hartford, Conn., to meet the requirements of the National Board of Underwriters. It is entirely new, and has been designed especially for the Edison three-wire system. When in operation it will break the positive, negative and neutral contacts simultaneously in two places. It has a carrying capacity of 30 to 40 amperes, the only size made at present, but other sizes will probably be placed upon the market. The size is particularly adapted to be placed at the junction boxes, where the service wires enter buildings. One of these switches will take the place of two double pole switches. The Gibbs switches are also made in single and double pole in all of the required sizes. They have been on the market only a short time, but the large demand for them is gratifying to the company, which is also manufacturing a complete line of sockets and dovetail rosettes, all of which are first-class goods, made in the best possible manner, electrically and mechanically. The company is extending its business in spite of the hard times, having this year opened offices in Boston, New York, Philadelphia and Chicago. The Chicago office is

COILED FILAMENT PACKARD.

located at 1536 Monadnock building, and is in charge of G. W. Conover.

Coiled Filament Packard.

The latest addition in the Packard lamp line is the coiled filament lamp shown in the accompanying illustration. The New York & Ohio company, manufacturer of the coiled filament lamp, has moved slowly in bringing out a lamp of this kind, preferring to wait until it became fully satisfied that it was the more desirable lamp under certain conditions. Arriving at this conclusion, it began the manufacture of the lamp illustrated. The coiled filament lamp is particularly adapted to high voltages, and at present the New York & Ohio company is furnishing it only for voltages ranging from 100 to 110 volts. The coil in the long filaments, in addition to concentrating the light, also prevents the filament from falling against the bulb and shortening the life of the lamp. Further than this, it renders the filament more rigid and less likely to be affected by the jarring of the building or its support, and gives a longer life in buildings which are subject to vibration from the operation of machinery or other causes. These lamps are handled by the Electric Appliance company, Chicago.

Electricity in Insurance Matters.

At a meeting of underwriters held in Chicago, June 20th, a committee was appointed to devise ways and means for organizing an electrical bureau and laboratory. It consists of Maj. C. E. Bliven, of the union electrical committee; Eugene Harbeck, chairman of local board commission No. 2; F. Bennett, of commission No. 1; William H. Cunningham, of No. 3; E. L. Allen, of No. 4; E. M. Teall, chairman of the executive committee of the Chicago Underwriters' association, and the chairman of the finance committee of the same organization. The plan, as roughly outlined at present, is to establish a bureau for the improvement of the electrical fire hazard throughout the Northwest. This bureau is to collect and disseminate data regarding fires resulting from electricity, and educate underwriters on electrical hazards. Outside of Chicago it will labor to secure uniform ordinances providing for electric wiring and installation. In the laboratory tests will be made of all sorts of electric appliances and wiring. It is proposed to manage the bureau through the Chicago Underwriters' association, with the electrical expert of that association in charge.

Electric Alarm and Pressure Gauge.

The object of the invention shown in the accompanying illustration is to provide an electric alarm signal for high or low pressure that can be attached to all forms of pressure gauges. At the same time, it is provided with a simple means of testing the gauge to ascertain if it is in working condition at all times, and also at the same time to test the signal bell or recorder. It can be attached to both the signal bell and to the recording clock and thereby give at all times a record of the pressure when it exceeds certain limits either high or low.

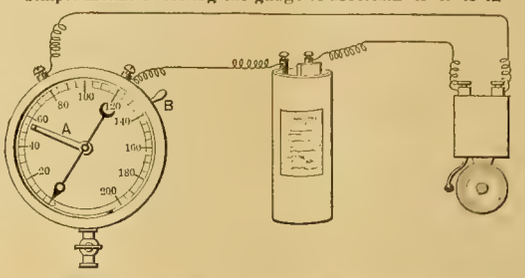


FIG. 1. ELECTRIC ALARM AND PRESSURE GAUGE.

In Fig. 1 is a plain view of the face of the common form of a pressure gauge, provided with the attachments. The small handle or finger, which is marked *B*, by being pressed either up or down, will test the gauge in either direction for high or low alarms, thus showing that both the gauge spring and the electric signal apparatus are in perfect order.

This gauge is of special value on the sprinkler systems. On the wet system of automatic sprinklers it is of great importance, as very often a defective head or other leak in a sprinkler system will start, or a fire cause a single head to go off. This one head or leak would not be sufficient to move the four or five inch check valve, to which the mechanical gong is attached, far enough to cause a positive alarm. This gauge can be set within one pound, if desired, of the pressure which is normally carried, thus indicating a leak at once. In dry systems it is valuable, because when a head goes off the air has to escape from the pipes before the water can be of any service, and thus time is lost before the alarm is given. The gauge, shown in Fig. 2, is so arranged that as soon as the head is opened and the air commences to escape, it will ring a bell long before the water will come through the pipes. It is also valuable to be used on a steam boiler, when the engineer or fireman has something else to attract his attention for a short time, and in that time the steam either raises or lowers. The gauge is manufactured and placed upon the market by the E. G. Barnard company, Troy, N. Y., and is simple, reliable and made of the best of material.

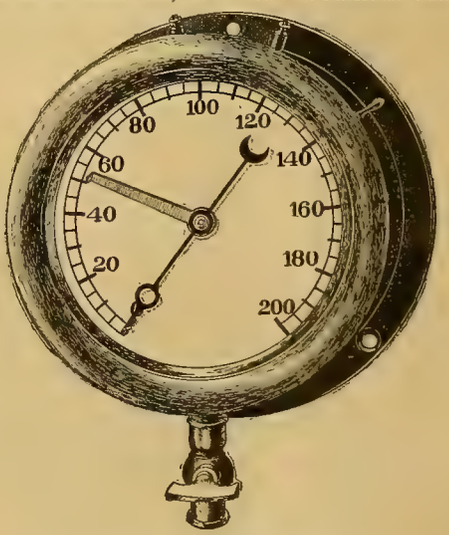
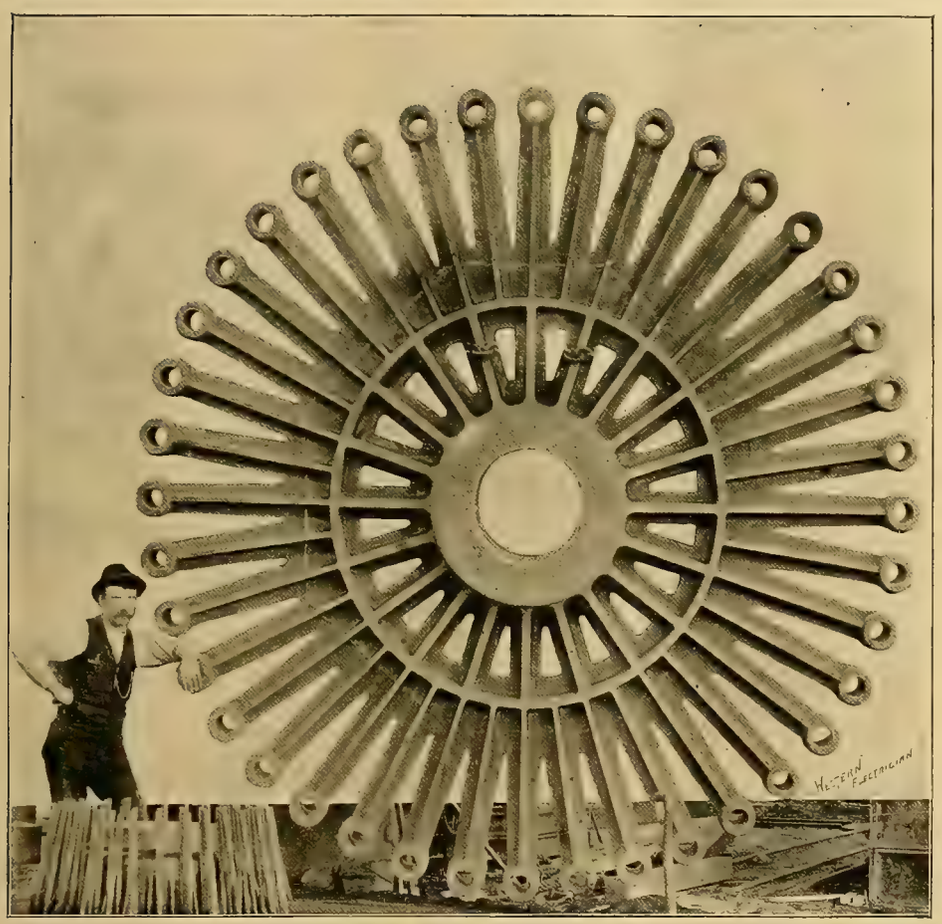


FIG. 2. ELECTRIC ALARM AND PRESSURE GAUGE.

A recent issue of the *New Review* contains an article on the telephone, in which the writer, Mr. Henniker-Heaton, says he "looks forward to the time when every private house in England will be supplied with a telephone service for £3 a year, and when it will be possible to speak with America and Australia."

Large Siemens & Halske Machinery.

The accompanying illustration represents one of a pair of armature stars or carriers which are said to be the largest in the world. A pair of these has recently been made by the Wells & French company for the Siemens & Halske Electric company of America, which will install them at Toronto, Ont., for street railway service. The machines when completed will weigh about 60 tons each and have a nominal capacity of 1,200 kilowatts or 1,600 electrical horse power each, under 500 volts pressure, and will be over compounded for 12 per cent. drop in the lines. They are to be directly connected to a pair of horizontal cross compound condensing engines, making 80 revolutions per minute. The armature stars are 13 feet in diameter and weigh over 10 tons each. The brush carriers will be about 14 feet six inches in diameter and are being made by the same concern. The castings came from the mold absolutely perfect, without a warp, crack, flaw or blow-hole and are now being finished for the armature. Considering the form and size and the difficulty in making these castings, the Wells & French company is to be congratulated upon the work.



LARGE SIEMENS & HALSKE MACHINERY.

New Telephone Company in Philadelphia.

It is announced that a new telephone system is to be introduced into Philadelphia by a syndicate which has been incorporated for the purpose, which will be known as the Clamond Telephone company. The object of the company is to introduce a French system in hotels, apartment houses, country residences, etc., and in railroad service. In France the system is operated by the Home Telephone company and has been officially adopted by the French government for the use of the army and navy. Over 800,000 of the instruments are in use in France, and Philadelphians recently returned from Paris speak in the highest terms of the practical working of the system. It is the intention of the syndicate to begin operations as soon as the charter for the Clamond company is secured, and it is probable that one of the first steps will be to experiment with the new telephone for railroad service, a number of the larger railroad companies having already become interested in the project.

The interurban electric street railway between Cleveland and Akron, O., is said to be an assured enterprise. The capital stock will be $300,000, and the company to operate it has been incorporated. The road will carry passengers and freight, and will be open to contracts for carrying the mail.

American Institute of Electrical Engineers.

At the last meeting of the council of the American Institute of Electrical Engineers, June 20th, the following named associate members were elected:

William K. Archbold, Boston, Mass.; John B. Blood, Schenectady, N. Y.; Edwin H. Bennett, Jr., Elizabeth, N. J.; George S. Bliss, Pittsburg, Pa.; Frank W. Brady, Lafayette, Ind.; Francis C. Caldwell, Columbus, O.; C. C. Chesney, Pittsfield, Mass.; Arthur Edwards Childs, Philadelphia, Pa.; John E. Criggal, Springfield, Mass.; A. L. Croxton, San Francisco, Cal.; H. C. Eddy, Chicago, Ill.; Philip G. Gossler, Brooklyn, N. Y.; Frederick L. Hutchinson, Newark, N. J.; George H. Harris, Birmingham, Ala.; Frank H. Knox, Baltimore, Md; L. G. Lilley, Wyoming, O.; Herbert Lloyd, Philadelphia, Pa; James P. Malia, Chicago, Ill.; Jos. Carl Mayrhofer, New York; Maurice Oudin, Schenectady, N. Y.; Charles Plumb, Buffalo, N. Y.; Albert Scheible, Chicago, Ill.; Joel W. Stearns, Jr., Denver, Col.; George Stephens, Peterboro, Ont.; Paul A. N. Winand, Philadelphia, Pa.

The following named associate members were transferred to full membership upon recommendation of the board of examiners:

George M. Mayer, Chicago, Ill.; Franklin S. Holmes, New York; Hollon C. Spaulding, Exeter, N. H.; Henry H. Wait, Chicago, Ill; Ernest P. Warner, Chicago, Ill.; H. Fleetwood Albright, Chicago, Ill.; F. N. Waterman, New York; D. McFarlan Moore, New York; Caryl D. Haskins, Boston, Mass.; Francis G. Daniell, New Haven, Conn.; Daniel W. Shea, Champaign, Ill.; W. LeConte Stevens, Troy, N. Y.; Arthur Newhall Mansfield, New York; Gano S. Dunn, East Orange, N. J.; Charles Wirt, Chicago, Ill.

The next meeting of the council will be held on September 19th. Thirty applications for membership are now on hand for consideration on that date.

Portable Electric Lights.

There has been placed upon the market a novelty in electric lighting which might have almost numberless applications if its operation is as reliable as the claims made for it. By reference to Fig. 1 an idea may be gained of the system employed. This lamp consists of battery and headlight complete in one compact case, and resembles in appearance an ordinary oil lamp. The battery is, according to the Chicago Electric Headlight company, Chicago, the manufacturer of the article, an improved form of secondary cell, and possesses the advantage of containing no liquid. This battery may be charged by primary cells or connection may be made with an electric circuit used for lighting purposes. This style of lamp is intended for use upon bicycles, but modifications of it exist which may be used by miners, policemen and those who need a bright light for frequent use. In Fig. 2 is shown another form of bicycle lamp, which is much like that intended to be used by miners. In this type of lamp the headlight and battery are detached, the headlight being carried on the front of the wheel, and the storage battery arranged under the seat or attached to the tubing of the frame, with a wire running hrough the tubing to the lamp. This company is also producing electric lamps for houses, carriages, headlights for street cars, locomotives, etc.

FIG. 2. PORTABLE ELECTRIC LIGHTS.

Moonlight Schedule.

Following is the WESTERN ELECTRICIAN'S moonlight schedule for July:

Day of Month.	Light.	Day of Month.	Extinguish.	Number of Hours.
	H.M.		H.M	H.M.
1 ..	P. M. 8 10	2....	A. M. 3 30	7 20
2....	" 8 10	3....	" 3.30	7 20
3 .	" 8.10	4....	" 3.30	7.20
4....	" 8 20	5....	" 3.30	7.10
5....	" 9.00	6....	" 3 30	6.30
6....	" 9.20	7 ..	" 3.30	6.10
7...	" 9 50	8. ..	" 3.30	5.40
8 ..	" 10.10	9....	" 3.30	5.20
9 ...	" 10 30	10...	" 3 40	5.10
10....	" 10.50	11...	" 3 40	4.50
11....	" 11.10	12....	" 3 40	4.30
12 ..	" 11.40	13...	" 3.40	4.00
13...	A M. 12.20	14....	" 3.40	3 20
15....	" 1.10	15....	" 3 40	2.30
16....	No light.	16....	No light.	0.00
17....	No light.	17...	No light.	0.00
18...	No light.	18....	No light.	0.00
19...	P. M. 8.00	19....	P. M. 9.50	1 50
20....	" 8.00	20....	" 10 20	2 20
21 ..	" 8.00	21 ..	" 10 40	2 40
22....	" 8.00	22....	" 11.00	3.00
23....	" 8.00	23....	" 11.10	3.10
24....	" 7.50	24....	" 11.40	3 50
25....	" 7.50	25....	" 12.00	4 10
26....	" 7 50	27....	A. M. 12.30	4.40
27....	" 7.50	28....	" 1.10	5.20
28....	" 7.50	29....	" 1 50	6.00
29....	" 7.50	30....	" 3.00	7.10
30....	" 7.50	31....	" 3.50	8.00
31...	" 7.50	Aug. 1	" 3.50	8.00
		Total.....		137.20

The foregoing schedule was calculated on the following basis:
Light one-half hour after sunset and one hour before moonset
Extinguish one hour after moonrise and one hour before sunrise.

Accident to Thomas A. Edison.

A dispatch from New York dated June 26th states that Thomas A. Edison, last Friday night at Ogden, N. J., where is located his experimental station, met with an accident. While sitting on the porch of his boarding house his chair gave way and he was thrown backward on the porch, striking heavily. Friends at once ran to his assistance, but he picked himself up and said he felt no pain or inconvenience. Saturday night he went home to Orange, N. J. Sunday he became worse. His family physician was called in. Monday Mr. Edison was worse and unable to leave the house. It is feared that some serious internal injury may have been sustained.

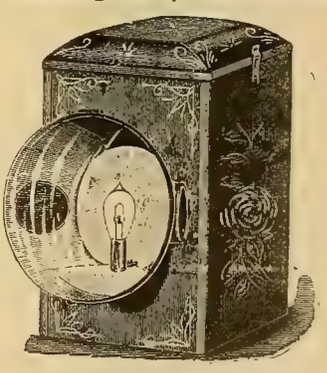


FIG. 1. PORTABLE ELECTRIC LIGHTS.

Cablegram from Mid-ocean.

An interesting cablegram was received at Chicago on Tuesday, June 26th, by the Siemens & Halske company of America. It was sent from the steamer Faraday in mid-ocean and contained the announcement that Arnold von Siemens of Berlin would reach Halifax about July 4th and that Alexander von Siemens of London would go to Ottawa, Can. Arnold and Alexander von Siemens are on the Faraday which is laying the new cable for the Postal Telegraph-Cable company, and this message was evidently sent from the ship to England by the new cable and then transmitted to New York and repeated to Chicago.

Proposed Electrical Test of Cuirasses.

There are now several so-called bullet-proof cuirasses before the public, and the question has arisen as to whether they contain metal plates other than steel or iron. With a view to testing the Dowe cuirass, the *Pall Mall Gazette* has made the following proposition:

We have devised and erected, in concert with Prof. Silvanus Thompson, F. R. S., the principal of the Finsbury Technical College, an electrical apparatus for proving whether or not the cuirass contains a metal plate, without in any way revealing the actual substance used. The apparatus consists of an induction balance arranged in the following manner: A large circular coil of fine wire is attached to the two poles of an alternating current dynamo. On either side of this is suspended a smaller coil wound on a bobbin, and connected right and left handedly in series with a telephone receiver. The position of the coils is so adjusted that the currents induced by the central or exciting coil exactly balance each other, when no vibration can be detected in the the telephone. If, however, a plate of any metallic substance, whether solid or built up, or constructed of gauze, be inserted between the central coil and either of the side coils, the balance is upset, and a clear ringing note is heard in the telephone. The action is so exact that no mistake can possibly be made, and sensitive enough to enable it to be at once detected whether the disturbance were caused by a large substantial plate or merely by fragments of bullets and steel fragments left inside the cuirass. If Herr Dowe and Captain Martin care to put their cuirass to this perfectly unexceptionable test, the apparatus is at their disposal, and we shall be pleased to invite Mr. Maxim to witness either his own triumph or his own discomfiture, and to collect a competent jury of scientific men and military experts, to be nominated by all parties concerned, in order to see the test fairly performed.

The apparatus devised for this test was exhibited before the Royal society on June 13th. It is said that Herr Dowe and Captain Martin do not desire to submit their cuirass to the proposed test.

CORRESPONDENCE.

New York Notes.

New York, June 25.—The rapid transit commissioners completed their organization last Tuesday at a meeting in the city hall by electing a secretary, counsel and chief engineer. Lewis L. Delafield, a lawer prominently identified with the City club, was selected for secretary; Henry R. Beekman and Albert B. Boardman counsel, and William Barclay Parsons, chief engineer. When the commission adjourned it was to meet on Thursday, June 28th, at two o'clock in the afternoon, in its new quarters. Meanwhile opinion of counsel will be obtained on several intricate questions in the rapid transit law on which there was a lengthy discussion at the recent meeting. Messrs. Orr, Low and Steinway were appointed a committee to call these and other law points to the attention of the lawyers.

Mayor Schieren of Brooklyn has vetoed the second series of resolutions by the aldermen granting a franchise to the New York & Eastern Telegraph & Telephone company. The first resolutions were vetoed by the mayor on the ground that the grant was contrary to public policy. The aldermen then passed the resolutions over the mayor's veto by a vote of 13 to 6. The mayor has found that the veto message was not printed in all the corporation newspapers, as required by law, and he holds that any attempt to pass the resolutions over his objections was invalid.

The New York Electrical society accepted an invitation from the officers of the Postal Telegraph company to visit and inspect its fine headquarters, Broadway and Murray street, on Tuesday evening, June 19th. Preceding the inspection the annual election of officers of the society was held in a room provided by the Postal authorities. The following named gentlemen were elected: President, C. O. Mailloux; vice-presidents, Dr. W. J. Morton, Dr. M. I. Pupin, Luther Stieringer, F. A. Pickernell, W. S. Barstow, C. S. Bradley; treasurer, H. A. Sinclair; secretary, Geo. H. Guy. Ex-President Joseph Wetzler was presented complete sets of Clerk Maxwell's and Siemens, works. Dr. C. E. Emery made the presentation on behalf of the society and thanked Mr. Wetzler for his services. Mr. Wetzler responded. The society inspected the new building, a description of which has been given in this journal. Mr. Sprague's elevator apparatus attracted much attention.

At a recent meeting of the stockholders of the United Electric Light & Power company, they authorized the president and secretary of the company to mortgage to the Union Trust company all the property, real and personal, and all the franchises, privileges and immunities of the company for $5,000,000. The money is to be used by the electric company to liquidate its floating indebtedness and to retire outstanding bonds, and also for the extension and development of the concern. Five thousand coupon bonds were issued at five per cent., aggregating $5,000,000.

There is great opposition to the extension of the trolley system at Passaic, N. J. Workmen last Friday prepared to erect poles in State street in front of the property of two families named Liebson and Davitt. They were set to work digging a hole in front of the home of Liebson. The mother and daughter, discovering this move, ran out and stepped into the hole, and there they staid, defying the workmen to molest them. The superintendent called his men away, and they started to dig in another spot. Mr. Liebson then came out and shoveled back the dirt as fast as the workmen threw it out. The laborers were more discomfited by the arrival of the relatives of Liebson. Most of the new arrivals were young women, who interfered with the laborers by grasping the shovels, while the male relatives filled up the holes as fast as dug. In spite of these difficulties the laborers succeeded in digging 10 holes, all of which were promptly filled up. At this point there was a little scuffle between one of the workmen and an old woman. She hit him and then knocked down Mr. Otis, the superintendent of the trolley workmen, who rushed in to protect the man. The police interfered and made the railroad men stop digging and dispersed the crowd of spectators. They could not, however, prevent the men from going across the street and breaking ground in front of Mrs. Davitt's building. Mrs. Davitt proved herself capable of handling the gang of men without calling for help from outsiders. A few cuffs and kicks drove them away.

W. F. O.

St. Louis, Mo.

St. Louis, June 23.—The subway commission has made a full report of its proceedings, and has submitted two bills providing for the placing of wires underground. These bills are now before the city council. The first bill provides that the city shall contract for the construction of a complete system of conduits, and that the entire system shall be leased to the city for a period of 25 years, at a fixed annual rental, the city subletting to the various wire-using companies. At the end of the 25 year lease the city is to acquire the entire system. The surplus revenue derived from rentals is to be set aside as a subway fund for this purpose. The bill provides that the last payment of purchase money shall not exceed 10 per cent. of the total cost. The city is required to maintain the conduits during the term of lease and will also construct such additional conduits as may be required during the lease, but in this case the ownership is vested in the city at once.

The board of public improvements is authorized to prepare plans and specifications for a subway system for containing all wires except trolley wires, and upon the completion of such plans to advertise for a period of 20 days, soliciting bids for the construction of the system and its leasing to the city. The plan contemplated covers that part of the city bounded on the east by the river, on the west by 22d street, on the north by Cass avenue, and on the south by Chauteau avenue, and is to be of ample capacity for all present wire-using companies with a reasonable reserve for future requirements. As many ducts as the supervisor of city lighting may designate are to be provided for city service. The work is to be divided into four equal sections, and the entire subway system completed within 24 months after the date of contract. The bill also provides for a permanent subway commission, whose duty shall be to fix the annual rental charges to be paid to the city by the several companies. The commission is to consist of the mayor, treasurer, auditor, comptroller and president of the board of public improvements, and will continue in existence during the term of the lease. A rough estimate places the cost of the subway system at $1,000,000.

The second bill is intended to complete all the minor details necessary for placing wires underground.

The Grand avenue railway has been purchased by the Union Depot Railroad company and construction will begin soon.

A report has been circulated lately that all street car lines in the city were to be consolidated. This is far from being an accomplished fact as yet. The matter has been broached to the street car companies, but they have done very little. Some of them are disposed to favor the scheme.

R. J. H.

PERSONAL.

B. J. Arnold, Chicago, left for Harrisburg, Pa., last Tuesday.

Dr. Louis Bell of the General Electric company, Schenectady, is in Chicago.

D. W. Guernsey, president of the St. Louis Electric Light & Power company, was in Chicago last week.

John A. Stewart of the Card Electric Motor & Dynamo company of Cincinnati was in Chicago last week.

M. E. Baird, general sales agent for the Eddy Electric Manufacturing company, Windsor, Conn., was in Chicago last week.

L. A. Ferguson of the Chicago Edison company returned to Chicago last Tuesday from a business trip of several days.

Benjamin M. Bruce of Bruce & Boardman, general electrical contractors, Memphis, Tenn., was in Chicago last week. Mr. Bruce combined a social trip with business interests.

Enos Bookwalter, who is well known in Detroit and elsewhere through his connection with the Detroit Electrical Works, is now connected with Frank B. Rae, 49 Wilcox street, Detroit.

B. E. Sunny of Chicago, general western manager, and W. F. Pope, Boston, second assistant treasurer, of the General Electric company, have been in Little Rock looking after the company's local properties.

W. F. White, of the power and mining department of the western office of the General Electric company, has resigned to take up other work. He formerly represented the General company at Omaha, and last summer had charge of its power transmission and mining display at the World's Fair.

The retrenchment policy that has been pursued by the General Electric company for the last eight months has brought about many administrative changes in the Chicago office. Manager Sunny has now taken personal charge of the lighting and supply departments, assisted by P. J. McFadden and F. M. Boyer for the respective departments named. Assistant Manager Bailey has direct supervision of the railway, motor, power transmission and mining departments, with the assistance of S. D. Flood for the last named department.

ELECTRIC LIGHTING.

Evart, Mich., has made a contract with the Standard Electric company of Chicago for a municipal electric light plant, which is to be completed by August 10th. Fifteen street arc lamps will be installed at first and about 300 incandescents.

The East River Electric company is being incorporated at Pictou, N. S., with a capital stock of $30,000 to supply New Glasgow, Stellarton, Westville and Ferrona with electric light produced by water power. With this object in view, the west branch of the East river of Pictou has been examined by engineers, who report that at the dryest season of the year 200 horse power may be developed by means of a dam 30 feet high, located near the village of Hopewell, N. S.

The electric illumination of the Northeast Sea canal has been let to the Helios company of Cologne, to be in operation by April, 1895. Along the two shores 884 incandescent lamps of 25 candle power each will be placed on posts 13 feet high at distances of 820 feet. Besides these lights, 68 others will serve to light better the 13 canal ferries and the four swing bridges. The locks will be lighted by 12 arc lights each, and the canal entrances will be shown by colored lights of long range. For the two stretches of 3,930 feet and 18,800 feet, where the canal traverses lakes, oil gas buoys are provided. The light stations are located at the two ends of the canal, at Holtenau and Brunsbuettel.

ELECTRIC RAILWAYS.

Plans are being made to build a new car line in Council Bluffs, Ia., running to a summer resort. Electrical business in the town is reported to be growing.

The Lanark County Electric Railway company of Perth, Ont., is applying for incorporation with a capital stock of $100,000, to build and operate an electric street railway in that town.

A bill has been introduced into the Massachusetts Legislature incorporating a company with a capital stock of $3,000,000 to operate the Boynton bicycle railway between Boston and Lowell. Electricity is the motive power of the system.

An express train on June 18th struck a trolley car about a mile from Paterson, N. J., and badly injured all the passengers. The gates at the crossing were up through the carelessness of the tender, and a freight train limited the view of the motorman.

A motorman on a Calumet electric railway car lost control of his car on the grade near One Hundred and Sixteenth street and Michigan avenue crossing in Chicago, June 24th, and it ran into a moving freight train on the Chicago & Eastern Illinois road. The car was filled with people most of whom received injuries in jumping. The electric car was

completely wrecked. The rails were wet, the brakes failed to hold the car, and the motorman did not reverse the motor in time to check its speed.

Steps are being taken to connect Hamilton and Toronto, Ont., by an electric road. It is proposed to run freight cars during certain portions of the day for the accommodation of farmers between the cities. Double decked passenger cars are favored.

Arrangements have, it is stated, been made by an English company for the establishment of a system of electric tramways in Havana, Cuba. The projected line covers about 20 miles in all, and is to connect the principal wharves and thoroughfares with the existing tramways.

A serious accident occurred June 10th on the Macon and Indian Springs electric car line, three miles north of Macon, Ga. The uncontrollable speed of the car as it turned a sharp corner threw out four persons 25 feet upon the rocks, and all sustained serious, although not dangerous, injury.

The rails for a new electric railroad in San Francisco, Cal., are being laid on Third street from Market street to the Southern Pacific depot. The horse car line which will thus be supplanted was the pioneer company in San Francisco, and the road has been operated from North Beach to the railroad depot since 1862.

A sweeping decision in favor of electric railroads was given by Chancellor McGill recently in a case in which the Camden, N. J., Gloucester & Woodbury Electric Railway company is interested. It had been enjoined temporarily from crossing the tracks of the West Jersey Railway company at Woodbury. The chancellor dissolved the injunction, holding that the electric system was but a modified horse railway system, and that companies had a right to erect poles along streets and highways without abutting property holders being entitled to any extra compensation.

The Gettysburg Electric Railway company recently filed a bill in equity in the United States Circuit Court asking to have the United States enjoined from prosecuting the condemnation proceedings to acquire the property of the railway company on the Gettysburg battlefield. The constitutionality of the act upon which the proceedings are based was attacked. Judges Dallas and Butler, after hearing only part of the argument, dismissed the motion to quash the petition of the United States for the condemnation of the strip of land claimed by the company which in its possession, it was held, would disturb the battle landmarks.

Judge McConnell will soon be called upon to decide concerning the efficiency of the contact breaker which measures the amount of electricity supplied by the Siemens & Halske company to the West & South Town Railway company, Chicago, for the operation of the electric line on Twenty-second street. Counsel for the Twenty-second street line charged the Siemens & Halske management with contempt of court for the alleged violation of an injunction restraining it from cutting off the current of electricity. The attorney for the Siemens & Halske Company said the stoppage of power was caused by the breaking of the contact breaker.

It appears that in Brooklyn the trolley car is used to catch pickpockets with. On Greenpoint avenue the other day a fellow snatched a lady's pocketbook and ran. The lady screamed. A trolley car was standing near by. The motorman gave his lever a yank and started in hot pursuit of the thief, who, not suspecting such a proceeding, cantered gayly down the street leaving the woman yelling on the sidewalk. He didn't even take the trouble to turn into a side street, and as a result the electric car overtook him within two blocks, and while the motorman sat on him the conductor called a policeman. The pickpocket threatens to have the street car employes prosecuted for running faster than the law allows, but as he will probably be in Sing Sing within a few days the threat is not taken seriously. Meanwhile gentlemen of larcenous instincts are confining their operations to streets upon which only horse cars are run.

TELEPHONE.

On June 13th the Bell Telephone company declared its regular three per cent. dividend, but the directors found that recent heavy loss of business would not warrant its issuance. This action was the cause of considerable surprise, it is said, and the company's stock fell from 203 to 197 within a few minutes.

TELEGRAPH.

The franchise granted to the New York & Eastern Telegraph & Telephone company to introduce a telegraphic system into Brooklyn has been vetoed by Mayor Schieren.

Judge Seeds has granted the receivers of the Atchison, Topeka & Santa Fe Railroad company time to show cause why an injunction should not be issued to restrain them from interfering with the Postal Telegraph company in the construction of a telegraph line along the railroad. The Postal company claims to have a contract with the railroad company granting it right of way, which the receivers refuse to recognize.

The police department of Boston astonished the public on June 21st by sending officers around to the hotels and the leading barrooms in the business district, and ordering all the stock tickers taken out at once. The tickers that have been ordered out, curiously enough, all belong to one company it is said. The machines of the United Telegraph company have not yet been disturbed. The company whose tickers have been objected to is the Stock Quotation Telegraph company.

Within a few months Pekin will be united by wire with St. Petersburg, and, in consequence, with the telegraph system of the entire civilized world. According to the latest issue of the *Turkestan Gazette*, the telegraph line from Pekin has been brought as far west as the city of Kashgar. The European end of the line is at Osh, and a small stretch of about 140 miles now alone breaks the direct telegraphic communication from the Atlantic to the Pacific.

The chief of police notified the superintendent of the Western Union Telegraph company at Jersey City, N. J., last week that in the future he must not receive cipher messages. The cipher messages referred to are the winning policy numbers, which are drawn in Connecticut and wired to Jersey City, to be distributed among the local policy players. The probability is, it is said, that the Western Union company will disregard the order of the chief of police, and in that event the matter will be taken before the grand jury.

The steamship Faraday sailed from Siemens Brothers' works at Woolwich, England, June 12th, having on board 1,600 miles of the Commercial company's new cable. She will proceed to a point 150 miles off the Irish coast, where she will splice on to the shore end already laid. She will then proceed to Nova Scotia, where the final splice will be made. The cable is expected to be laid by June 30th. A dinner was given on board the Faraday, at which a distinguished company was present. Among those invited were Lord and Lady Kelvin, Sir Benjamin Baker, George G. Ward, vice-president of the Commercial Cable company; Clarence Mackay; W. H. Preece, C. B., engineer-in-chief and electrician of the British Postoffice; Sir Charles Tupper, Canadian high commissioner; Arnold Von Siemens and G. H. Hambridge.

MISCELLANEOUS.

Cleveland, O., will have a double swing bridge on Columbus street that will be operated by electricity.

Judge Lea on June 16th rendered judgment in favor of the General Electric company against the Little Rock, Ark., Electric Street Railway company for $7,627. The case has been in contest for a long time.

A horde of sewer rats, which pestered a down-town restaurant keeper, have been decimated by an ingenious electrician, says the Philadelphia *Record*. The rodents came up day after day through holes alongside a grated covering of a sewer inlet in the yard back of the restaurant. The electrician offered to construct an effective trap, and he was told to go ahead. He laid coils of copper wire about the hole and made an attachment to the electric light wires within the building, supplying a key to turn on the current. A watch was kept on the hole, and when a dozen rats were running about the yard the key was turned. As the rats returned, one by one to their holes, they keeled over dead. In this novel way nearly 150 rats have been killed off in a little over a week.

An important addition to the literature of the World's Fair—a work of especial interest to electrical men—is Prof. John P. Barrett's forthcoming book entitled "Electricity at the Columbian Exposition." The volume will consist of about 600 pages, with 120 large half-tone illustrations, and will be handsomely printed, with especially designed inital letters and tail-pieces, and tastefully bound. It will contain an exhaustive description of the electrical service plant, the exhibits in electricity building, decorative lighting, searchlights, telephone and telegraph service, Intramural railway, electric launches, electric fountains, police and fire alarm service and miscellaneous electrical applications of the World's Columbian Exposition—in short, a comprehensive survey of all the electrical features of the World's Fair. The book is now in press and will be issued shortly.

TRADE NEWS.

Among the recent installations of the Detroit Electrical Wiring & Repair company, Detroit, may be mentioned a complete plant of over 500 lights for the public library, wiring the D. M. Ferry buildings for 500 lights with salamander wire, a complete installation for the Wilson flats, and a conduit system for the Detroit Museum of Art, all of Detroit.

The Peru, Ind., Electric Manufacturing company is making a special feature of its No. 2 Hercules battery. This battery consists of a fluted carbon cylinder or vase filled with a depolarizing compound. The large surface of zinc exposed makes it one of the best batteries for open circuit work. The cell is charged with six ounces of sal ammoniac and 28 ounces water and has an electromotive force of 1.47 volts; internal resistance .11 ohm, and current on short circuit about 13.4 amperes.

The Detroit Motor company, Detroit, Mich., has recently installed a 400 light plant in the drug establishment of Farrand, Williams & Clark, Detroit, including generator, Erie City engine, Detroit motor and marble switchboard. It has also installed a 300 light dynamo in the club house of the Detroit Boat club, which, it is said, is one of the finest of its kind in the United States. A complete 250 light plant has also been ordered by the Rickel Malt company, Detroit. The company's well-known fan motor is also in great demand.

The Hubley Manufacturing company, Lancaster Pa., manufacturer of electric railway and lighting apparatus, is in a position to supply the trade from its extensive stock of electrical goods. This stock includes everything in electric wire supplies, lighting supplies, street railway appliances, including P & B electrical compound, car electroliers, insulators, both glass and porcelain, construction tools, etc. The company has issued a catalogue containing a list of its goods, which gives some idea of the size of the stock which the company carries. The book is a price list, and an examination of it shows prices which are satisfactory.

The University of Wisconsin has commenced the publication of an engineering series of papers in its bulletin. No. 1, Vol. 1, is "Track," by L. F. Loree, and No. 2 is "Some Practical Hints in Dynamo Design," by Gilbert Wilkes. Judging from the value of these first two lectures, the university has adopted a wise course in preserving them in book form. Mr. Wilkes is the chief engineer of the Detroit Electrical Works, and in his lecture he has touched upon many practical points which are of much interest. The committee of publication for the university consists of Charles Kendall Adams, George L. Hendrickson, William H. Hobbs, Dugald C. Jackson and F. J. Turner.

The annual register of Purdue University, Lafayette, Ind., for 1893–1894, with the scheme of study for 1894–1895, shows the institution to be in a prosperous condition, the portion of the building which contained the foundery and woodworking shop which was damaged by fire some time ago having been repaired. A number of additions have been made to the facilities for engineering and experimental work. The electrical engineering department of the university is extensive and is designed for those wishing a thorough and practical fitting for electrical engineering. As the practical electrician needs to be acquainted with the principles of machinery and the methods of machine work, this course has been based on that in mechanical engineering, differing essentially from it only in the technical courses of the junior and senior years. To meet the demands of the technical work in this branch, nothing but the most thorough course in the fundamental facts and principles of the science of electricity and magnetism can prove satisfactory, hence, a thorough drill by means of text-books and an extended series of careful measurements with exact instruments forms the necessary preparation for the latter work. The department is well supplied with dynamo-machines, motors and testing instruments for the most advanced investigation of the various problems of electro-technics. Particular attention is given to the designing of electrical machinery and appliances. The inspection of electrical installations of various kinds is considered part of senior year work. The department is in charge of H. B. Smith, A. W. Duff, W. E. Goldsborough and F. W. Brady.

BUSINESS.

The suit of George Maitland against Alfred C. Gibson, in Philadelphia, for alleged infringement of a patent for combined gas and electric fixtures, has been dismissed.

James B. Olson, Chicago selling agent for the New York Insulated Wire company, reports business as being good. His sales for May last were in excess of those for the same month a year ago.

The Westinghouse Electric & Manufacturing company has been having great success with its new direct current series arc light system. Orders have already been booked for a sufficient number of installations to keep this department busy for some time to come. The electric generating machinery is made in 25, 40 and 60 lights capacity.

The Royal Electric company, Peoria, Ill., has recently shipped the following machines: One 1,000 light alternator; one 750 light alternator and one 70 horse power 500 volt generator to Tama, Ia.; one 500 light alternator to Richland Center, Wis., and one 1,000 light alternator to Denison, Ia. The company reports a decided increase of business.

Cameron & Gillett, electrical engineers and contractors, 49 Wilcox street, Detroit, Mich., have met with considerable success since entering the construction business. They have installed quite a number of complete electric light plants in Detroit and vicinity within the last few months and have received a number of unsolicited testimonials for their excellent workmanship.

The Metropolitan Electric company, Chicago, is introducing a novelty in the W. E. Garey battery gauge. This instrument is particularly efficient and reliable, and indicates absolutely the actual working capacity of open circuit batteries. The sales of this company continue to be of the most satisfactory character, and it is pushing the sales of the Kester arc lamp with renewed vigor.

The Electric Appliance company, Chicago, is exhibiting in its Chicago salesroom quite an elaborate line of Carpenter heating appliances, which have attracted considerable attention. The Meston motor is doing good service as an alternating fan motor that may be depended on in any kind of exacting service, and a flow of orders has commenced, which will probably continue until well along in the season.

The Machinery Supply company, Los Angeles, Cal., is opening a supply house and proposes entering the field for contracts for complete installations to include isolated plants, central stations and street railway lines and power houses. The company would also like to correspond with manufacturers not represented in Southern California and Arizona. George E. Nolan, a member of the firm, and formerly superintendent of the Fulton Iron Works, is the mechanical engineer, and H. C. Wybrow, recently superintendent of the street railway and lighting plant at Everett, Wash., is the electrical engineer.

The new vertical compound engine of 600 horse power capacity, built by the Ball & Wood company for the Chi-

cago Edison company of Chicago, which was inspected in March last by so many of the prominent eastern engineers, has been placed in position at the Twenty-seventh street station, Chicago, and is now awaiting the completion of the dynamos. Among the recent contracts secured by the Ball & Wood company are those of the engines for the Manayunk & Roxborough Incline Plane railway, for the Poughkeepsie & Wappingers Falls Electric Railway company, Athol Gas & Electric company, Geneva Brush Light & Power company, and the Morris County Electric company.

The Chicago Water Motor & Fan company, 101 Lake street, Chicago, reports that its business has been of a satisfactory character in spite of the dull times. This company manufactures an electric ceiling fan which is enjoying a large sale and which is making a meritorious record for itself during the excessive warm weather. In addition to this specialty the company also manufactures a full line of belt fans to be driven by an independent motor and an extensive line of exhaust fans, which are being widely used for power house plants in reducing the temperature in dynamo and engine rooms. The company solicits correspondence regarding its products and is in a position to give attention to orders at once.

Frank B. Rae, the well known electrical engineer of Detroit, Mich., who is doing a general constructing business, has installed a 1,000 light plant with 26 kilowatt directly connected generators and Ideal engines, in the Wayne county house. The state house of correction has accepted his specifications for a directly connected plant, which will be installed as soon as the state makes the necessary appropriation. He has also put up a 600 incandescent light plant in Everett, Mich., including an Erie City engine and a 220 volt Standard machine. Mr. Rae makes a specialty of designing dynamos and motors for manufacturers, and will make tests and reports upon steam and electric plants. His wide experience in the electrical field makes his services in great demand to those desiring an expert in installing an electric plant of any kind.

The Union Brass Manufacturing company, with offices and plant at 123-127 Ontario street, Chicago, is now pushing an aggressive exploitation of the Mosher arc lamps. This concern is the consolidation of the Chicago Nickel Works, the Reiman company, and the Mosher Electric company, and besides manufacturing the Mosher arc lamp will make cabinet hardware, hardware specialties, and will do metal plating of every description. A. Weinberg is the president of the Union Brass Manufacturing company, and will manage its affairs. The company starts with a good business man at the helm, as Mr. Weinberg was the late treasurer of the Adams & Westlake company of Chicago. With the reputation which the Mosher lamp has already to its credit, it is fair to presume that the Union company will make this branch of its business a successful one.

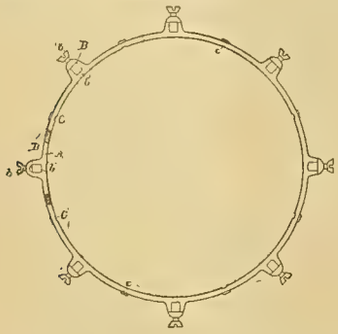
ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued June 19, 1894.

521,455. Electric Railway Signal. Charles R. Alsop, Middletown, Conn.

The invention relates to that class of electric railway signals in which a contact device is employed, and is operated by the wheel of a car to complete the circuit with a signal bell or visible signaling apparatus, and it has for its object to provide a contact device which is engaged by the flange of the wheel, and with the flange and the rail forms a part of a circuit, to avoid the use of auxiliary mechanism for communicating the motion of the wheel-operated device to a remote circuit controller, and to provide for a direct and positive operation of the parts resulting from the interposition, between the rail and the contact device, of the flange of a wheel.

521,461. Combined Annunciator and Spring Jack. Henry M. Fisk, Chicago, Ill.



NO. 521,671.

This invention relates to switchboards for telephone exchanges and comprises the combination in a switchboard of an annunciator drop adapted to hang in front of the jack and be lifted by the operator's plug as it is thrust into the jack and a trigger or arm for catching it when so raised and an electromagnet and its armature and connections by which the support is drawn from engagement with the drop when the magnet is energized.

521,514. Telephone Switch. Alfred Stromberg and Andrew Carlson, Chicago, Ill.

The invention comprises a switch located upon the receiver of a telephone, in a position conveniently to be closed by the hand of the person holding the telephone to his ear. The switch may serve to open and close the circuit through the subscriber's bell and generator, the primary circuit of his induction coil, or for any other desired purpose

521,516. Lamp Lighter. Albert H. Todd, Senatobia, Miss.

The inventor describes a lamp combined with a supplemental chamber preferably arranged as the base or stand of the lamp, this chamber containing the elements of a galvanic battery, and having electrical connection with a platinum coil at the wick by which the lamp may be lighted by rendering the battery active.

521,550. Printing Telegraph. Edwin Pope, Quebec, Que.

In carrying out this invention a series of 28 electro-magnets, each of which is capable of operating either of two different type levers, all the levers being arranged to strike a common center when operated. By this means the apparatus is capable of printing 56 different characters. Beside the 28 printing magnets, two shifting or switching magnets are provided by means of which either of the type levers of any magnet is operatively connected with the armature of the magnet at will. For controlling the circuits of all of the typewriter magnets, a series of relays is employed at the receiving station, and actuate the relays in every instance by three changes in the condition of the circuit. That is to say, in order to print any given letter or character at the receiving station, there are caused at the transmitting station, successively, three changes of the circuit and different letters are printed at will by varying the character of the changes, or the order in which the changes occur. A strong negative current, a weak negative current, a strong positive current, or a weak positive current may be sent over the line, or the line may be affected by no current at all. Each one of these conditions of the circuit affects different relays at the receiving station, and by joining them in groups of three in different orders and combinations one can operate any selected one out of the group of typewriter magnets and print any character chosen within the capacity of the apparatus.

521,553. Electric Railway Signal. Barney Samuels, St. Joseph, Mo.

This invention relates to electrically operated signaling devices for railways, by which the engineer of the moving train will automatically receive a warning signal apprising him of the condition of the road ahead.

521,562. Conduit Electric Railway. Thomas Armat, Washington, D. C.

One of the principal objects of this invention is to provide an improved form of contact device, by which the current may be conducted to the motors of the vehicles without direct engagement between the traveling contacts and the conducting leads, The invention also embraces several other improvements in electric conduit systems.

521,602. Trolley Pole Catcher. Owen G. Cates, Jr., St. Louis, Mo.

The invention consists in the provision on the reach-arm of a trolley device of improvements for releasing the tension of the trolley supporting springs upon the escape of the trolley wheel from the overhead conducting wire. The primary object of the invention is to obviate the striking of the trolley against supporting wires when it becomes wild and jumps from the trolley wire.

521,651. Electric Railway Car Motor. John C. Henry, Westfield, N. J.

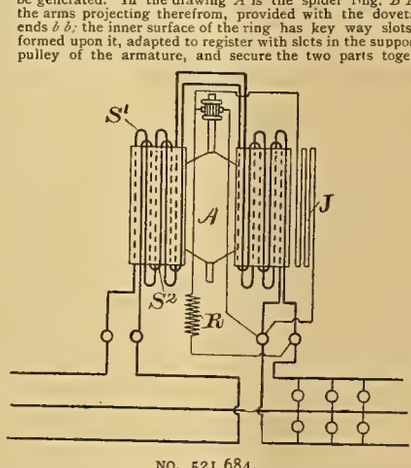
Improvements in electric motors for street railways are claimed in this invention, the objects being to simplify the construction, reduce the number of working parts, and lessen the losses usually attending the regulation of railway motors. A motor is described having a multipolar field magnet of high resistance provided with a pole changer in circuit with the field only and mechanism for operating the pole changer synchronously with the armature.

521,666. Alternating Current Regulator. Olof Offrell, Middletown, Conn.

The invention relates to electrical apparatus using an alternating current, and its object is to regulate or adjust the quantity of current consumed by the apparatus. It is especially applicable to incandescent electric lamps. The inventor avails himself of the counter-electromotive force, developed in a helix, to oppose the current flowing into the translating device. In the case of an incandescent lamp, this results in a dimming of the light; so that in such an application of the invention, it affords a means of regulating the light emitted by the lamp.

521,671. Armature for Dynamo-electric Machines. Edwin W. Rice, Schenectady, N. Y.

The invention relates to armatures for dynamo-electric machines, particularly to the spiders used in such constructions to support the core disks in place. Spiders cast in a single piece of solid metal have disadvantages on account of the eddy currents which arise in such constructions as they revolve in the field of force, which heat the spider and the armature conductors and impair the efficiency of the machine. Unsatisfactory contrivances have been devised to secure the core disks firmly in place on the spider. These two disadvantages are obviated in the inventor's construction, in which he provides a spider having radial arms provided upon their ends with dovetailed projections adapted to register with corresponding holes in the laminæ; and these arms are also provided with a lug or projection over which the end ring may be slipped, when the whole is compressed by insulated bolts, and a very rigid construction is provided. To obviate the objection of eddy currents, the inventor splits the mass of the spider arms, they being the parts which revolve in the strong magnetic field, by means of slots interrupting their continuity to such an extent as to greatly prevent the circulation of current, and also insuring, in cases where proper spacing of the laminæ is made, an efficient ventilation of the armature adapted to carry off any heat which may be generated. In the drawing *A* is the spider ring, *B B* are the arms projecting therefrom, provided with the dovetailed ends *b b;* the inner surface of the ring has key way slots *C C* formed upon it, adapted to register with slots in the supporting pulley of the armature, and secure the two parts together.



NO. 521,684.

Bolt holes *c c*, are also provided at one or more points, the bolts inserted through them serving to prevent the spider from creeping longitudinally on the face of the pulley. Through each of the spider arms is an opening *b'*, through which a part of the armature conductors may pass, the problem of passing such conductors around the projecting part of the spider in the large armatures now constructed being solved by this feature.

521,684. Meter for Recording Measurements of Electric Power. Elihu Thomson, Swampscott, Mass.

The invention has for its object to improve the construction of the recording wattmeter for which a patent has been granted the inventor and adapt it for use upon the three-wire system of distribution, as well as to adapt the meter to different potentials so that it may be used to register either between the two outside wires of the three-wire system, or between one of such wires and the neutral wire; at the same time so arranging the field magnet coils of the meter that its torque is evenly distributed around the armature, and thus in case one side only of the system is in use, or in case one side is carrying a great preponderance of the current, the registration will still be correct, and will be effected without damage to the armature. To attain the ends pointed out, the field-magnet coils shown in the drawing, which represents the connections of the armature in shunt across both the outside mains, are arranged between the outside wires of the system and distributee upon both sides of the armature *A*. The inventor arranges two independent sets of coils connected so that a part of each set is upon each side of the armature. The armature is arranged in shunt, with a resistance *R* in series with it, and a starting coil *J* is provided with just sufficient power to overcome the friction coefficient of the moving parts and in multiple with the armature and in series with the resistance.

521,685. Electric Meter. Elihu Thomson, Swampscott, Mass.

NO. 521,721.

The invention relates to improvements in electric meters such as have been described by the inventor in a former patent (448,894.) It has for its object to provide a method and means of starting such a meter under small loads and particularly to provide a means of providing an initial field or energy supplying circuit sufficient to overcome the friction coefficient of such meters. For this purpose is provided, in addition to the series coil of the meter, an auxiliary or shunt coil wound in relation to the armature in such a way as to furnish the field required.

521,711. Supply System for Electric Railways. Thomas Harris, Detroit, Mich.

The invention relates more specifically to that class of electric railways in which the motor circuit during the travel of the car is maintained in multiple connection between a sectional working conductor and a return conductor, or the ground, and in which the sections of the working conductor are automatically connected and disconnected from the power line by the operation of electric switches operated by the travel of the car. The invention consists in the peculiar construction and arrangement of the device by which the system is equally well adapted to single or double track roads, and further in the novel construction and arrangement of the switching devices by which a single magnet for each section of the working conductor controls the operation of the switching devices in a simple and efficient manner. The invention also includes an arrangement of sectional return conductor which may be used in connection with the system.

521,721. Electric Lamp for Bicycles. George Mayr, Brooklyn, N. Y.

The invention, the application of which is shown in the illustration, which is self evident and demands no particular description, consists in the combination with a bicycle having a sprocket wheel mounted on the hub of one of its wheels, a dynamo-electric generator of special design, suitably disposed upon the bicycle frame, and consisting in part, of a gearing frame piece, a horizontal armature shaft carrying a pinion, and a train of gearing mechanism, disposed in the frame piece, the initial driver of the gearing mechanism being carried by a shaft having a sprocket wheel mounted upon it and the final driver thereof being adapted to mesh at all times with the pinion on the armature shaft; an electric lamp of any approved construction, mounted on the bicycle frame, and circuit connections leading from the generator to the lamp.

The first claim of this invention reads:

A dynamo-electric generator, consisting of top and bottom frame pieces, each provided with a suitable head, having a clamping device pivotally connected therewith, suitable field magnets and a gearing frame portion, connecting the top and bottom plates, a lateral bearing piece secured to the magnets, a horizontal shaft carrying suitable armature parts, a commutator, and a pinion, the shaft being disposed transversely between the field magnets, and bearing respectively at its inner and outer ends in the gearing frame-portion and lateral bearing piece a train of gearing mechanism within the frame portion, the initial driver of the gearing mechanism being carried by a shaft having a sprocket wheel mounted thereon, and the final driver being adapted to mesh at all times with the pinion on the armature shaft, and two suitably disposed commutator brushes, one being directly connected with one of the field magnets,

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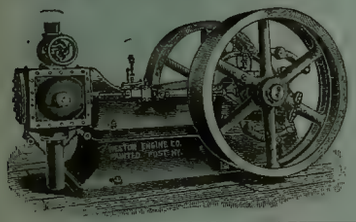

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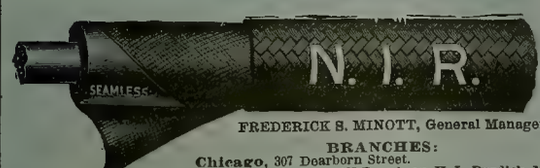

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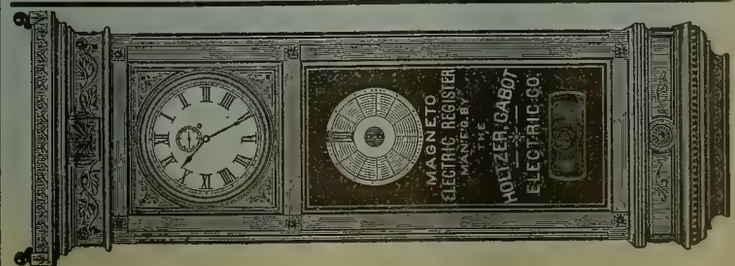

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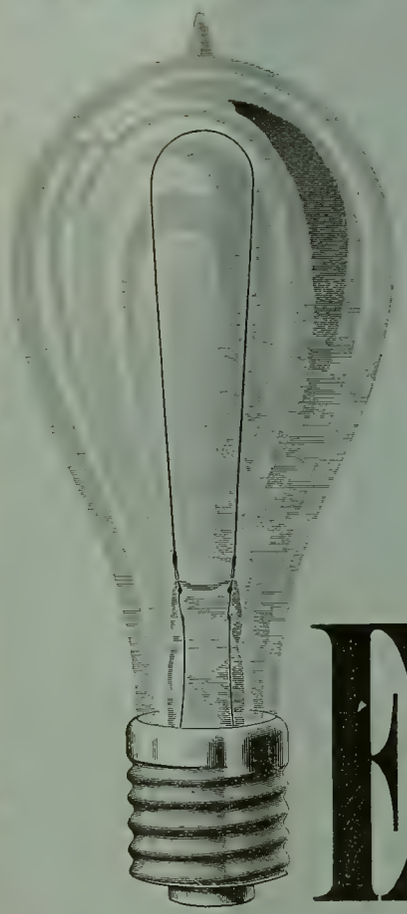

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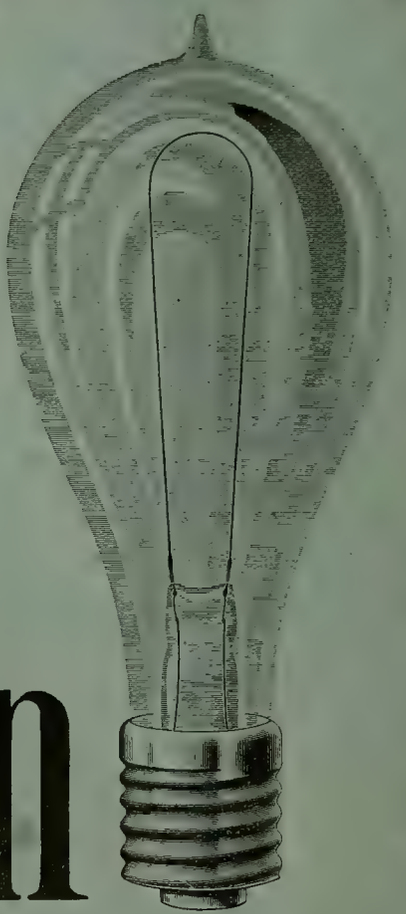

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Crescent Ins. Wire & Cable Co.
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Central Electric Co.
Electric Appliance Co.
Electric Selector & Signal Co.
Greely & Co., The E. S
Knapp Electrical Works.
Metropolitan Electric Co.
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Ind. Rub. & Ins. Wire Co.
Knapp Electrical Works.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons' Co., J. A.
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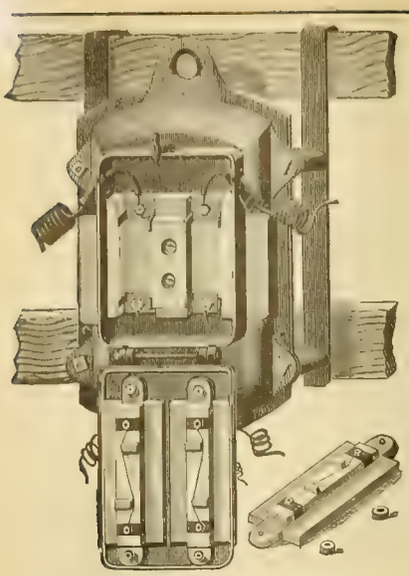

THE DIAMOND TRANSFORMER.

We offer in these transformers a combination of

Quality,
Convenience,
and Low Cost,

That cannot fail to attract central station managers. Write for catalogue and prices.

TAYLOR, GOODHUE & AMES,

348 Dearborn St., CHICAGO.

Ornamental Arc Lamps

For Direct and Alternating Incandescent Circuits.

Incandescent Lamps at Rock Bottom Prices.

*We solicit your orders. Almost Everything, Almost Immediately, For Almost *Nothing.*

*Figuratively Speaking.

Our Individual Arc Light and Motor Cut-Outs

ARE

RELIABLE,

ECONOMICAL,

SIMPLE,

And Require Only One Small Wire.

ELECTRIC SELECTOR & SIGNAL CO.

(Successor to ELECTRIC SECRET SERVICE CO.,)

45 Broadway, NEW YORK.

Important to Lighting Stations!

OUR NEW

ALTERNATING CURRENT INDICATORS

Are now ready. Before purchasing elsewhere send for our Supplementary Catalogue which contains the prices and description of the above instruments, and also a list and prices of other *new instruments* of our manufacture.

Whitney Electrical Instrument Company,

146 Franklin Street, BOSTON, MASS.

Penacook, N. H., U. S. A.—FACTORIES:—Sherbrooke, P. Q., Canada.

AGENTS:

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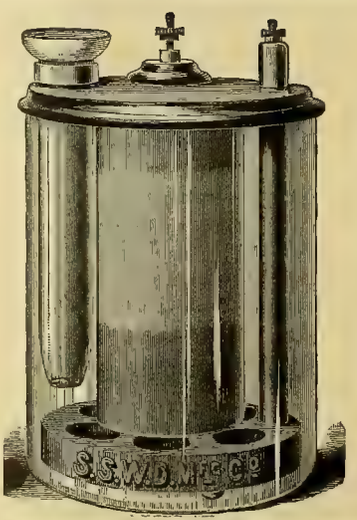
Montreal, P. Q., T. W. Ness & Co.
New York City, Geo. L. Colgate, 136 Liberty St.
San Francisco, Cal., California Electrical Works.
Toronto, Ont., Toronto Electrical Works.



THE PARTZ Acid Gravity Battery.

(Patented.)

The Highest Voltage and Most Constant Open Circuit Battery.

Use the Partz Sulpho-Chromic Salt.

(Patented.)

No handling of Fluid Acids or Mixing of Chemicals.

Send for our Catalogue, and let facts convince you.

Our Exhibit at the Chicago World's Fair is in the West Gallery of Electricity Building.

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Philadelphia, New York, Boston, Chicago, Brooklyn, Atlanta

STREET LIGHTING FROM ALTERNATING CURRENT DYNAMOS.

New Prices given on **Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters**

And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.

This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.

OUR SERIES LAMPS

Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.

BERNSTEIN ELECTRIC COMPANY, 620 Atlantic Ave., Boston, Mass.

WORTH A BUSHEL OF MEDALS!

An Award from the World's Fair that is a Testimonial of Real Merit.

HERE IT IS:

MECHANICAL AND ELECTRICAL DEPTS.
CHAS. F. FOSTER, MECHANICAL ENGINEER.
R. H. PIERCE, ELECTRICAL ENGINEER.

OFFICE OF
D. H. BURNHAM, DIRECTOR OF WORKS,
WORLD'S COLUMBIAN EXPOSITION,
JACKSON PARK,
CHICAGO.

December 7th, 1893.

Central Electric Co.,
Chicago, Ills.

Gentlemen:-

I beg to acknowledge receipt of yours of the 25th ult., asking about what experience we have had with the Okonite wire furnished for Fire and Police circuits at the World's Fair Grounds. I note that you received a letter from me stating that I knew nothing about this wire. The letter to which you refer was written by my Assistant during my absence, and the wire which you furnished was all used up before he had anything to do with this portion of our work.

The wire to which you refer was used nearly all, or wholly, for underground work in ducts, which were much of the time filled with water and ice, and I have never had any report of any trouble on these circuits due to the insulation of it. To the best of my knowledge they have worked satisfactorily all the time.

Yours very truly.

R. H. Pierce
Electrical Engineer.

Geo. A. McKinlock, President & Treasurer — Cable Address "MACKINLOCK-CHICAGO" — Charles E. Brown, Secretary

General Western Agents
OKONITE TRADE MARK
The Okonite Company, Ltd
The Interior Conduit and Insulation Company

Central Electric Company,
Manufacturers, Importers & Jobbers of
Electrical Supplies.

Chicago, Dec. 12, 1893.

R. H. Pierce, Esq.,
Electrical Engineer, World's Columbian Exposition,
Jackson Park, Chicago.

Dear Sir:-

We have your valued favor of the 7th inst., and beg to thank you for the information contained therein in regard to your experience with the Okonite wire furnished you for Fire and Police Circuits at the World's Fair Grounds.

We look upon your testimony as of more value than a bushel of medals, and beg to assure you that we appreciate your kind expressions.

Yours truly,

Central Electric Co.
Geo. A. McKinlock
Treasurer.

Copy.

WRITE NOW FOR OUR NEW CATALOGUE,

Happy New Year

For the 26th Time.

1868 TO 1894.

DAY'S KERITE

The Oldest and Best High Grade Insulation for Electric Wires and Cables.

For over **quarter of a century** Kerite has held an enviable position at the head of all known compounds for Insulating Electric Wires and Cables. No other compound has ever attained to the same degree of **"excellence, high insulation, durability and reliability, under the most exacting conditions,"** as Kerite—invented by Austin Goodyear Day over twenty-six years ago and manufactured to-day by his relative and successor

W. R. BRIXEY.

The recent award at the World's Fair to **Kerite** for the above qualities over all other compounds, together with the testimonials of its users, and the enormous demand for it by the most conspicuous and important electrical enterprises in this country, prove this beyond all question.

Since we last wished you Happy New Year many interesting events have transpired in the World's History:

The monarchy of Hawaii has been overthrown.

The World's Fair with all its imposing magnificence has come and gone.

The great Ferris Wheel with all that pertained to it has become a back number, but

KERITE

like the Rock of Ages, endures forever.

CUSHING & MORSE,

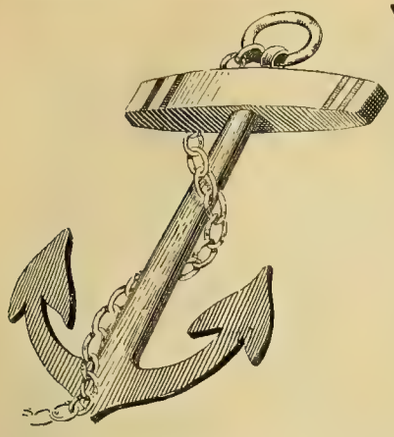
General Western Agents,

225 DEARBORN STREET, CHICAGO.

W. R. Brixey, Manufacturer.

J E. Ham, General Agent,
203 Broadway, NEW YORK.

California Electrical Works,
SAN FRANCISCO,
CALIFORNIA AGENTS.



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Incandescent Lamp

IS THE SAFEST LAMP TO PURCHASE NOWADAYS,

BECAUSE

IT IS ANCHORED TO THE ONLY PRINCIPLE OF SUCCESS.

STERLING QUALITY, NOT CHEAP MATERIAL OR WORK.

No Lamp is Cheap that is not Good.

A bit of Correspondence:

When he ordered:

"Don't send Lamps unless you know they are good. We have been annoyed long enough with poor lamps."

When he remitted for Anchor Lamps:

"The Anchor has given better satisfaction than any other lamp we have tried. Send another barrel at once by express."

We give a Guarantee with a Meaning.
"A Lamp that Will Live."
"A Lamp we will Protect against Litigation."

Prices are right, It will pay you to write us.

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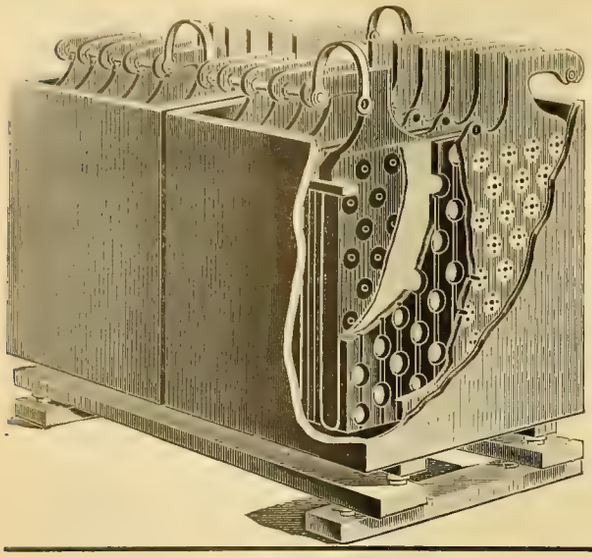

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Are Guaranteed to Meet Their Rated Capacities.

NO Applied Oxides. Buckling. Short Circuiting. | Durable. Efficient. High Capacity. | CELLS FROM 10 TO 5,000 AMP. HOURS.

Central Station and Traction Cells A Specialty.

Prompt Shipments. Catalogue Gives Facts and Figures. Send for it.

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THE WADDELL-ENTZ CO.'S

Direct-Connected Railway and Lighting Generators.

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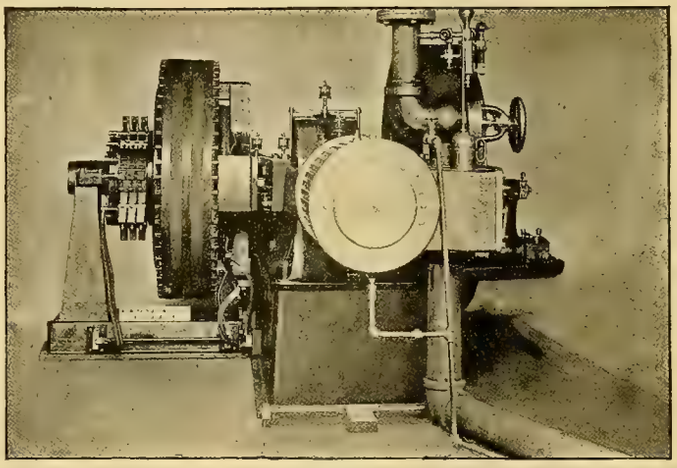

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SLOW SPEED SAVES IN REPAIRS AND BREAK-DOWNS.

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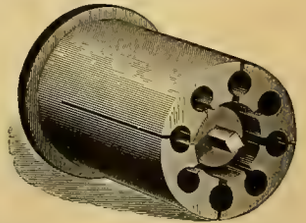
HIGH ELECTROMOTIVE FORCE. SMALL INTERNAL RESISTANCE.

LITTLE LIABILITY OF CARBON BREAKING IN SHIPMENT.

SUITABLE FOR BELLS AND GAS LIGHTING.

Prices on Application.



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Liquid Insulating Compounds

AWARDED THE HIGHEST MEDAL AT THE FAIR OVER ALL COMPETITORS.

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SOLE MANUFACTURERS

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THE NEW LAMP

For Alternating Circuits, 30 or 50 Volts.

Simplest and Best.
Most Positive in Action.
Embodies New Ideas in Every Detail.
Low in Price.
Made in Various Ornamental Styles.

WRITE FOR CIRCULAR.

Don't forget that we also carry a most complete line of arc lamps for constant potential circuits, street railway circuits, etc.

Electric Construction & Supply Company,

UNITY BUILDING, CHICAGO. ESTABLISHED 1881. TELEPHONE BUILDING, NEW YORK CITY.

THE NEW PUMPELLY-SORLEY STORAGE BATTERY.

THE BEST, LIGHTEST, STRONGEST AND MOST DURABLE STORAGE BATTERY IN THE WORLD.

Electro-Chemically Made. No Applied Active Material. Impossible for it to become Short Circuited.

Specially Constructed for Street Car Traction, Central Stations, House and Train Lighting, Electric Launches, Phonographs, Dentists' Use and Cautery.

WE MAKE THESE BATTERIES OF ANY CAPACITY REQUIRED FROM 150 TO 100,000 AMPERE HOURS.

We wish to form subsidiary companies throughout the United States, and will supply full information upon application to

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VULCANIZED FIBRE CO.

ESTABLISHED 1878.
SOLE MANUFACTURERS OF
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In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

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SPECIAL ALTERNATING ARC LAMP

Can be run three in series from 105 volt secondary circuit.

STANDARD ALTERNATING ARC LAMPS

Can be run in multiple from 50 or 100 volt secondary circuits by Spencer Economy Coils.

No Special Transformers Necessary. No Dead Resistance Required. No Change of Wiring.

SPECIAL NOTICE.

Helios Carbons will be sold only with the Helios Lamp. The Helios is the only lamp that has a legal right to use the reflector plate between the standards, without which one-half of the light is wasted.

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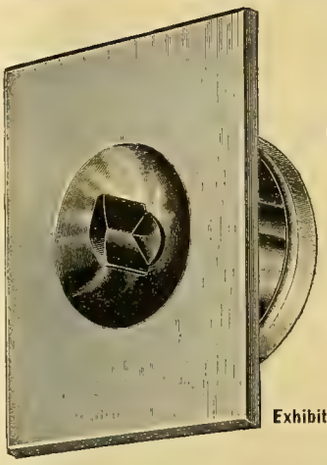
HART FLUSH SWITCHES.



5 and 10 Ampere Single Pole.
10 Ampere Double Pole.
10 Ampere Three-way.

The Only Snap Switch that has

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For Sale by All Supply Houses.

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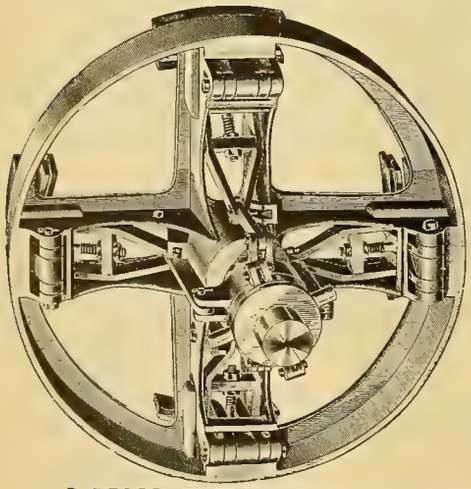

THE EWART FRICTION CLUTCH.

Especially designed for heavy duty at high speed, and fully guaranteed.

Complete Power Equipment for Electric Plants.

The Standard Water-Tube Safety Boiler.

Coal and Ashes Handling Machinery.

MANUFACTURED BY

LINK-BELT MACHINERY CO.,

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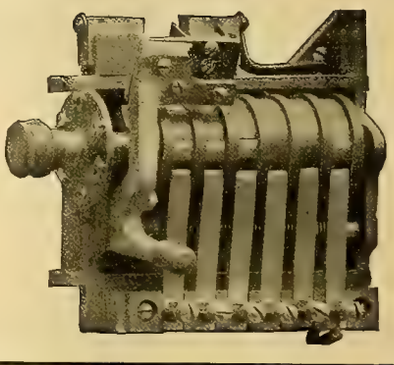
COMFORT. **SAFETY.**



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Regulating Switch Gives

FIVE DIFFERENT INTENSITIES OF HEAT.

In Practical Operation in More Than 25 Leading Cities in U. S. and Canada.

A NEW BOOK.

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AN UNPARALLELED RECORD.

TRANSMISSION OF POWER.

The Cataract Construction Company has awarded to the **Westinghouse Company** the contract to furnish the electrical apparatus for transmitting the power of **Niagara Falls** to operate manufacturing plants, and for other purposes. This is the most important contract in the history of the electrical industry. The initial installation alone amounts to 15,000 H. P.

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The two largest contracts ever made in this country for **Incandescent Electric Lighting Machinery,—The World's Fair** plant and the plant for the **Louisville Gas Company,**—were both awarded to the Westinghouse Company, and the installations furnished with **Westinghouse Alternating Current Apparatus.**

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The largest street railway companies in **Brooklyn, Jersey City, Philadelphia, Pittsburg, Chicago, Cincinnati, Indianapolis,** and **St. Louis,** have equipped their systems with **Westinghouse Electric Railway Apparatus.**

The above facts have undoubtedly an important meaning to all purchasers of electrical apparatus.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

BRANCHES IN ALL LEADING CITIES.

Our latest editions of catalogues are now ready for distribution.

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Is the most desirable catalogue of

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BEGIN RIGHT BY BUYING

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RE-winding
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ARMATURES, FIELDS and CONVERTERS.

Motor and Dynamo Inspection and Maintenance.

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NOTE THIS: **No Commutator, No Brushes, No Revolving Armature!**

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SUPERIOR TO COTTON WASTE. SAFE, DURABLE AND CHEAPER.

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Representative work now in course of construction, 2 000 H. P. Heat, Light and Power Plant for the Pabst Heat, Light & Power Co., Milwaukee, Wis.

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161 HIGH ST BOSTON
HIGHEST GRADE
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SEND FOR CATALOGUE
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Cleats, 2 or 3 wire, glazed,	**$30.**	per	1,000
Insulators, "	**12.**	"	"
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Guaranteed 98/99% and free of lead and iron. If you want the best quality ask your dealer for this brand. Imported by

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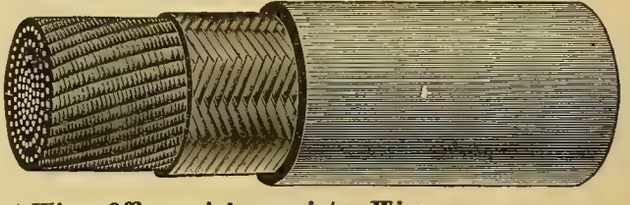

Magnet Wire, Office and Annunciator Wire,
Lead Covered Cables, Copper Wire, Telegraph Wire.

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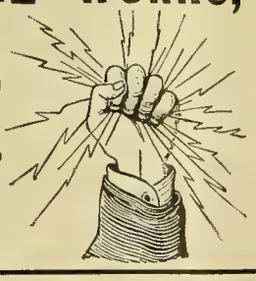
RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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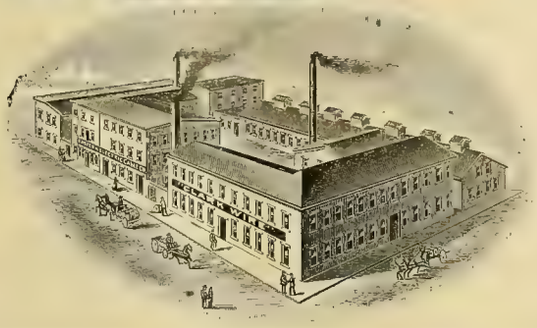

In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."

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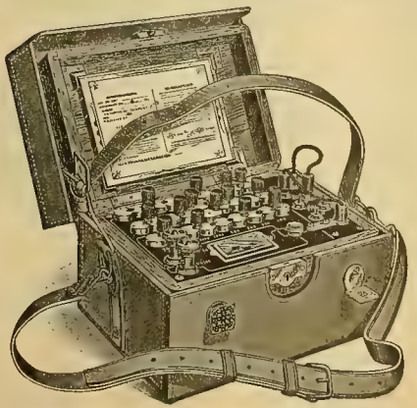

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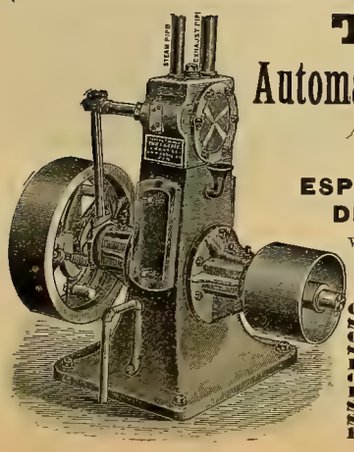

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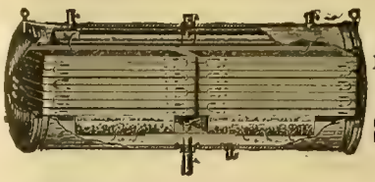

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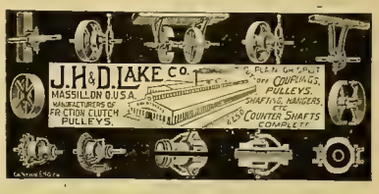

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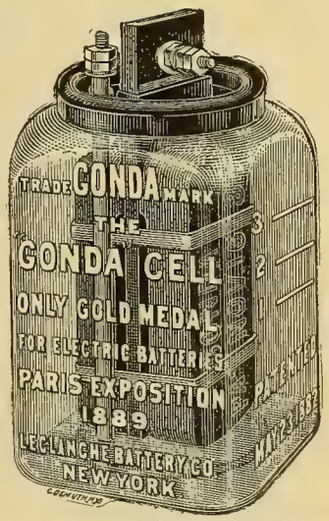

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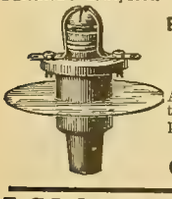

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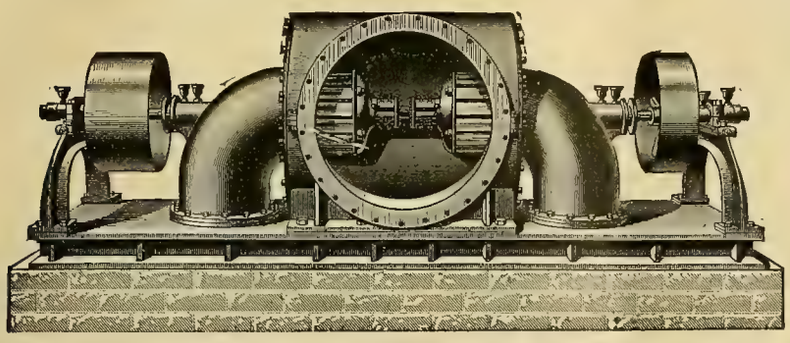

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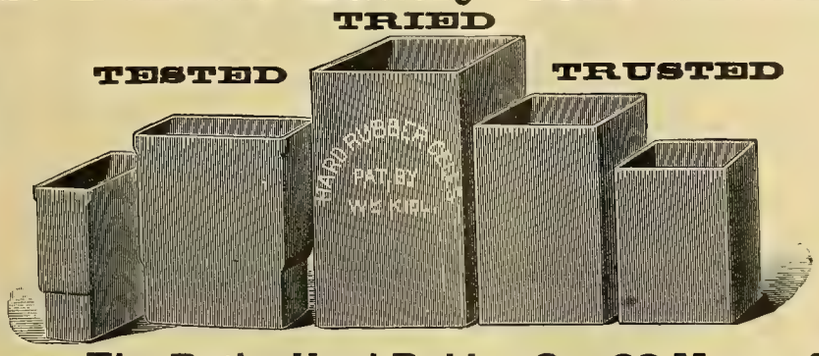

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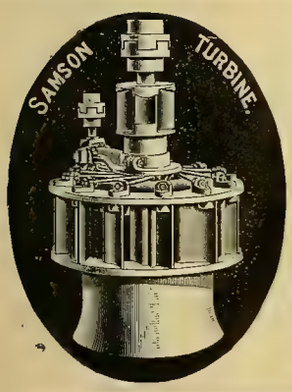

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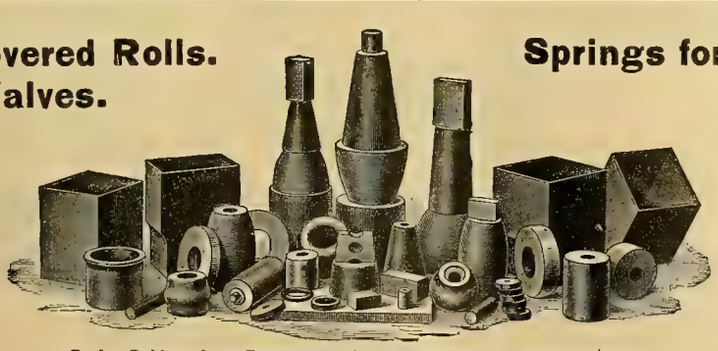

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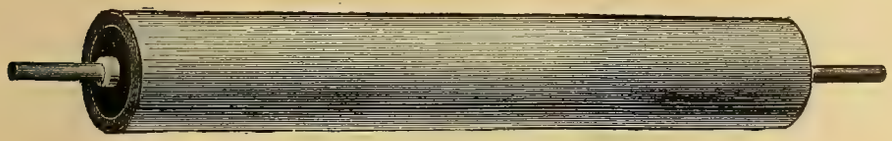

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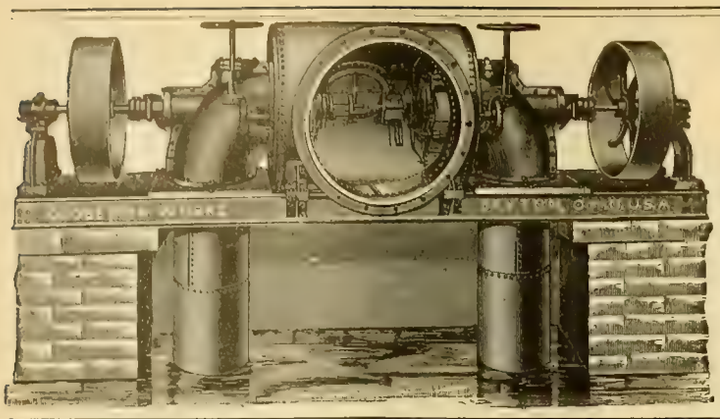

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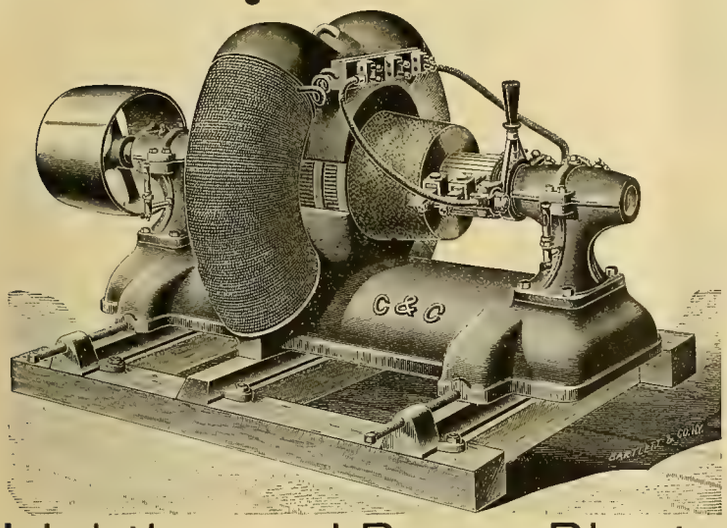

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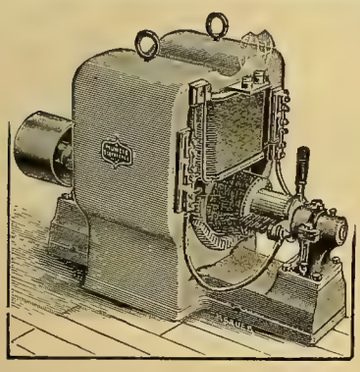

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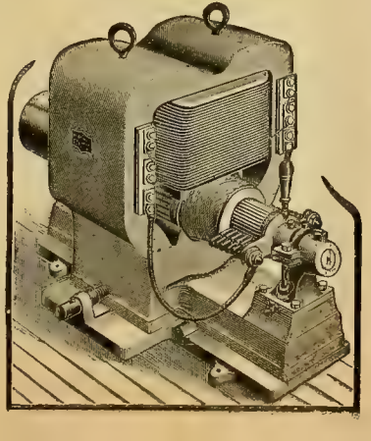

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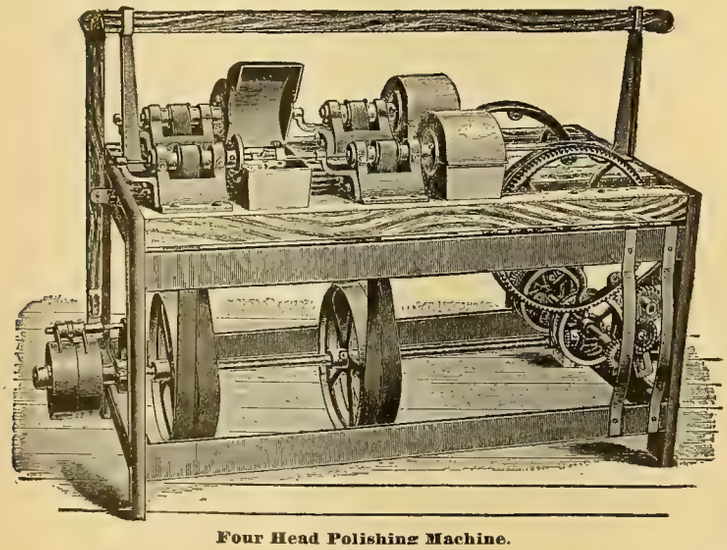

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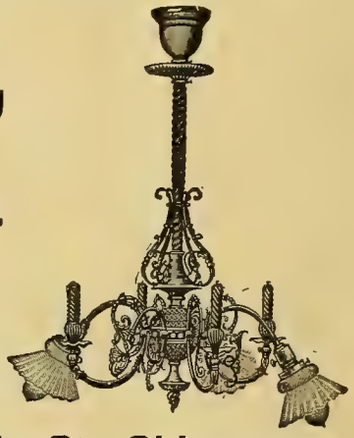

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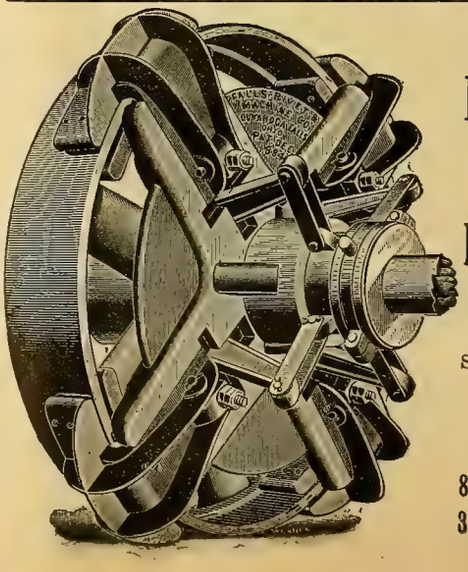

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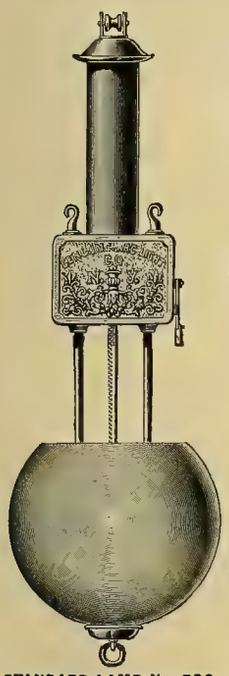

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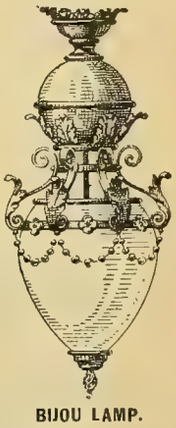

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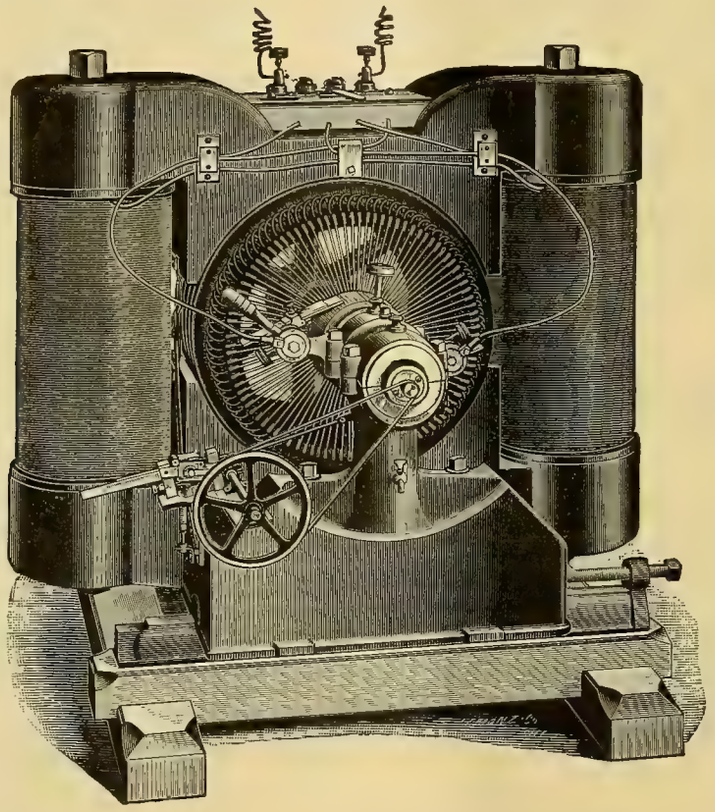

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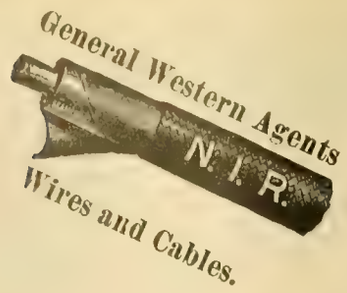

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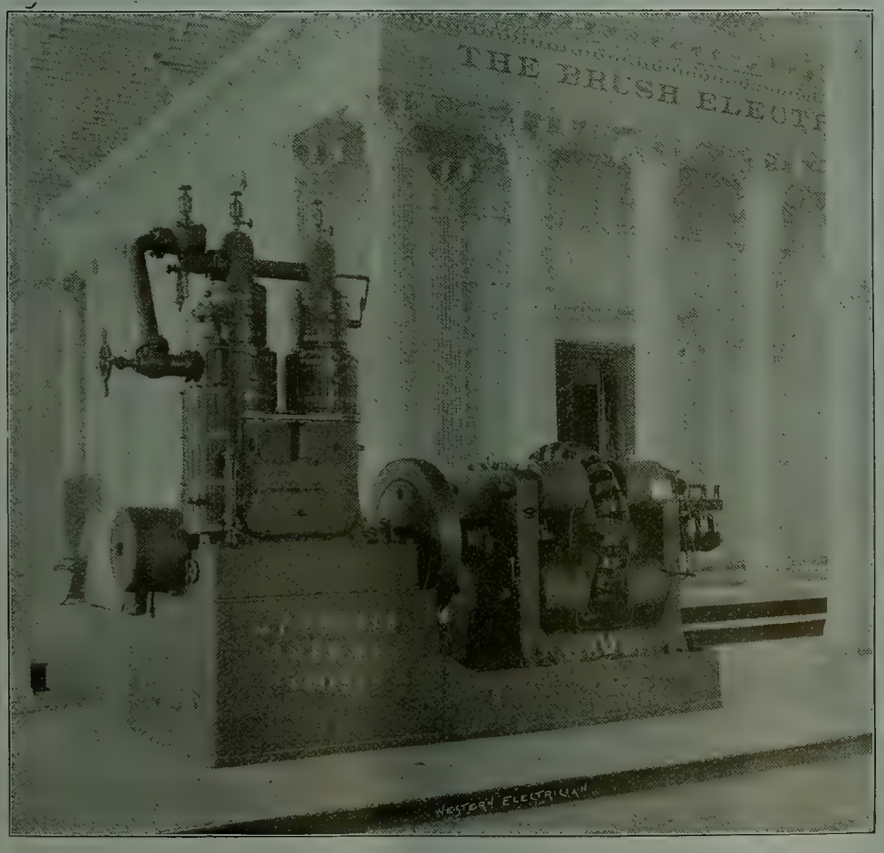

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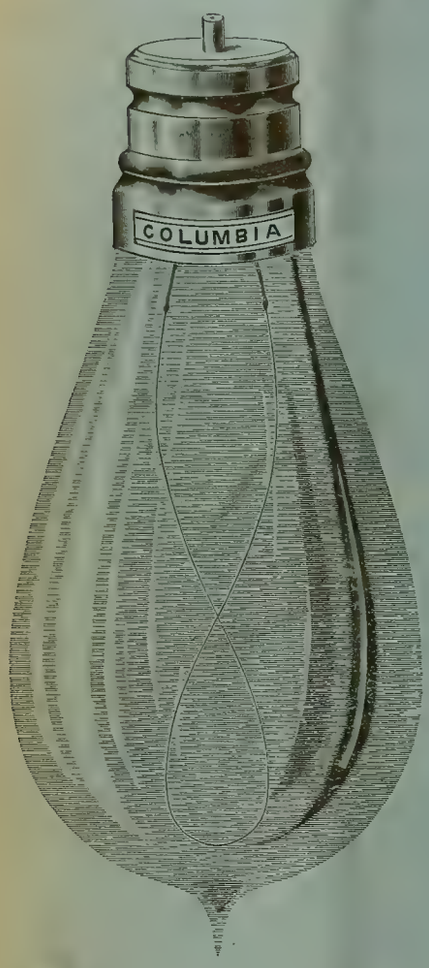

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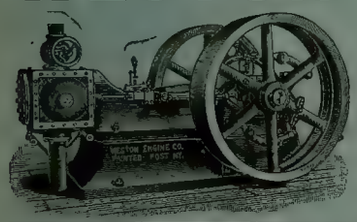

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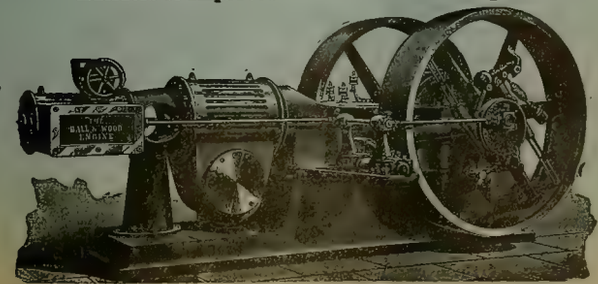

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Carter & Co.. Geo. G.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Spruance, D. C.
Taylor, Dee & Mack.
Western Electric Co.

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Falls Rivet & Machine Co.
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Arnold, B. J.
Brush Electric Co.
C. & C. Electric Co.
Carter & Co., Geo. G.
Compiete Elec. Const. Co.
Comstock, Louis K.
Ford-Washburn Storelec.Co.
Fort Wayne Electric Co.
General Electric Co.
Great Western Mfg. Co.
Muncie Elect. Works.
Osburn, Harry G.
Royal Electric Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
United Elec Improvement Co
Waddell-Entz Company.
Westinghouse Elec & Mfg. Co.
Western Electric Co.
Wilson & Jackson.

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Allen-Hussey Co.
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General Electric Co.
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Pullman Electric Co.
Sioux City E. S. Co.
Western Electric Co.
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Miamisburg Electric Co.

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American Electrical Works.
Bernard Co., The E. G.
Bishop Gutta Percha Co.
Bunnell & Co , J. H.
Carter & Co., Geo. G.
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Electric Appliance Co.
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Iona Mfg. Co.
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Bunnell & Co., J. H.
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General Electric Co.
Greeley & Co., The E. S.
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First Cost Does Not Decide It.

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St. Louis, January, 1892.

GRAND BILLIARD HALL.

In reply to your letter inquiring about service of your lamps, I am compelled to acknowledge them to be *the best lamp I have ever used* for life and brilliancy. I put in one hundred of your 24 c. p. lamps on July 8, 1891, and have quite a number of them in use yet. My average run is $10\frac{1}{2}$ hours per day for seven days a week. These lamps still maintain their candle power so well that it is almost impossible to distinguish the old from the new lamps. Respectfully,

C. A. COLLETT, *Engineer.*

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"AMERICAN" LAMP
IS "EFFICIENT."

After using your lamps for three months, we find in them *more than you represented* as to their life and efficiency. In proof of their efficiency we would say, we are easily carrying 276 of your 16 c. p. lamps on our dynamo, Edison pattern, while the estimated capacity of same is only 225 16 c. p. lamps at 101 volts. We are also pleased to say that, notwithstanding the overload, we are not troubled with heating of commutator or bearings, which we know to have been the case before your lamps were used on this dynamo. We will soon place another order with you. Yours truly,

St. Louis Refrigerator & Wooden Gutter Co.

THE
"AMERICAN" LAMP
IS "QUITE SATISFACTORY."

Municipal Electric Lighting and Power Co.,
Offices, 511 N. Fourth St.

St. Louis, September 14, 1892.

During the past year we have used many of your lamps and have found them *in all particulars quite satisfactory*, which you no doubt have understood because of the continuance of the orders.

Yours truly,

JAS. I. AYER, *General Manager.*

THE
"AMERICAN" LAMP
IS "MOST ECONOMICAL."

THE MOST ECONOMICAL.

We have used your American Lamp for the last six months and are very much pleased with them. Indeed, think it *the most economical lamp* that Street Railway Company can use.

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Are now ready. Before purchasing elsewhere send for our Supplementary Catalogue which contains the prices and description of the above instruments, and also a list and prices of other ***new instruments*** of our manufacture.

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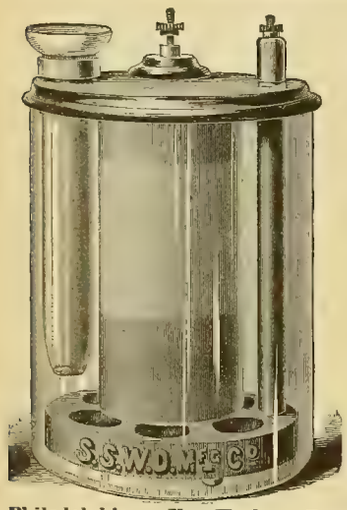

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Use the Partz Sulpho-Chromic Salt.
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SPECIAL ALTERNATING ARC LAMP
Can be run three in series from 105 volt secondary circuit.

STANDARD ALTERNATING ARC LAMPS
Can be run in multiple from 50 or 100 volt secondary circuits by Spencer Economy Coils.

No Special Transformers Necessary. No Dead Resistance Required. No Change of Wiring.

SPECIAL NOTICE.
Helios Carbons will be sold only with the Helios Lamp. The Helios is the only lamp that has a legal right to use the reflector plate between the standards, without which one-half of the light is wasted.

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CHICAGO.

MECHANICAL AND ELECTRICAL DEPTS
CHAS. F. FOSTER,
MECHANICAL ENGINEER.
R. H. PIERCE,
ELECTRICAL ENGINEER.

December 7th, 1893.

Central Electric Co.,
Chicago, Ills.

Gentlemen:-

I beg to acknowledge receipt of yours of the 25th ult., asking about what experience we have had with the Okonite wire furnished for Fire and Police circuits at the World's Fair Grounds. I note that you received a letter from me stating that I knew nothing about this wire. The letter to which you refer was written by my Assistant during my absence, and the wire which you furnished was all used up before he had anything to do with this portion of our work.

The wire to which you refer was used nearly all, or wholly, for underground work in ducts, which were much of the time filled with water and ice, and I have never had any report of any trouble on these circuits due to the insulation of it. To the best of my knowledge they have worked satisfactorily all the time.

Yours very truly.

R. H. Pierce

Electrical Engineer.

Geo. A. McKinlock, President & Treasurer

Cable Address
"MACKINLOCK-CHICAGO"

Charles E. Brown, Secretary

General Western Agents
OKONITE
TRADE MARK
The Okonite Company, Ltd
The Interior Conduit and Insulation Company

Central Electric Company,

Manufacturers, Importers & Jobbers of
Electrical Supplies.

Chicago, Dec. 12, 1893.

R. H. Pierce, Esq.,
Electrical Engineer, World's Columbian Exposition,
Jackson Park, Chicago.

Dear Sir:-

We have your valued favor of the 7th inst., and beg to thank you for the information contained therein in regard to your experience with the Okonite wire furnished you for Fire and Police Circuits at the World's Fair Grounds.

We look upon your testimony as of more value than a bushel of medals, and beg to assure you that we appreciate your kind expressions.

Yours truly,

Central Electric Co.

Geo. A. McKinlock

Treasurer.

WRITE NOW FOR OUR NEW CATALOGUE.

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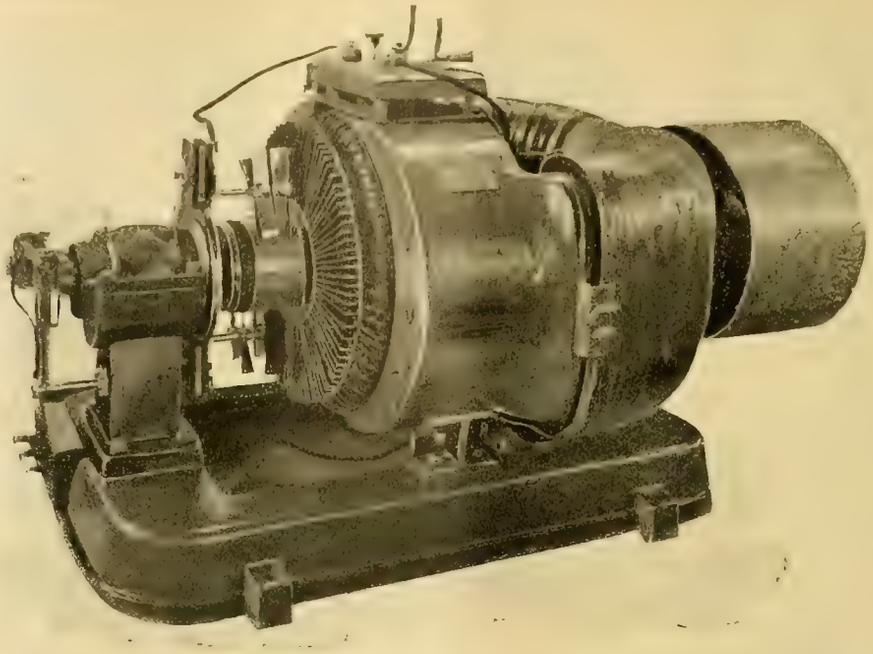

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10 Years' Continuous Service

Demonstrate the Value of this System.

REGULATOR Contains fewer parts than any Regulator in service, enables machine to be operated from Dead Short Circuit to full quota of lights. **REGULATOR**

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600,000 pounds of Safety, Grimshaw, Okonite, and E. M. W. Rubber Covered Wire, varying in size from 0000 to 18 B. & S. This wire has been purchased by me from the World's Fair, and must be sold in Sixty Days.

The wire has been used UNDER COVER, IS AS GOOD AS NEW, and will be sold CHEAP FOR CASH.

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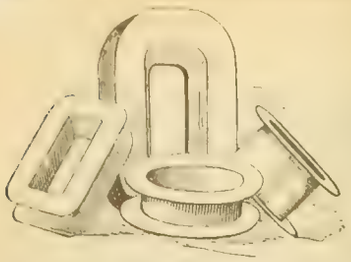

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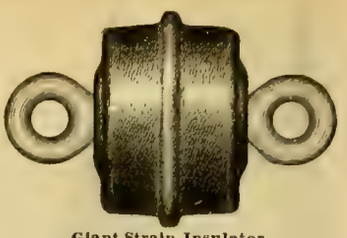

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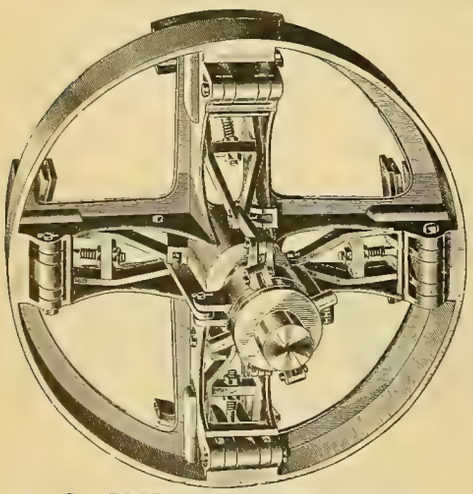

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Complete Power Equipment for Electric Plants.

The Standard Water-Tube Safety Boiler.

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Made Electro-Chemically.
No Applied Active Material or "Paste."
Plate made from one integral piece of rolled lead.
No joints; no solder.
High efficiency, capacity and durability guaranteed.
Lighting plants and central station auxiliaries installed.
Portable cells, all sizes.

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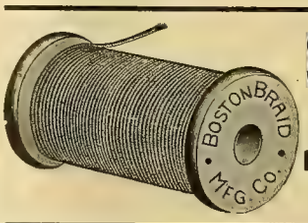

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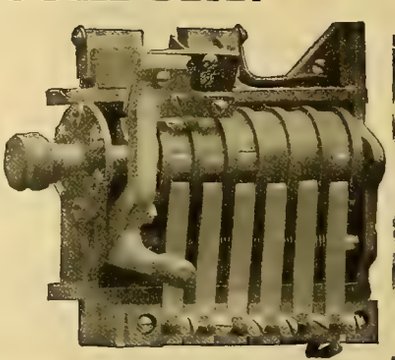

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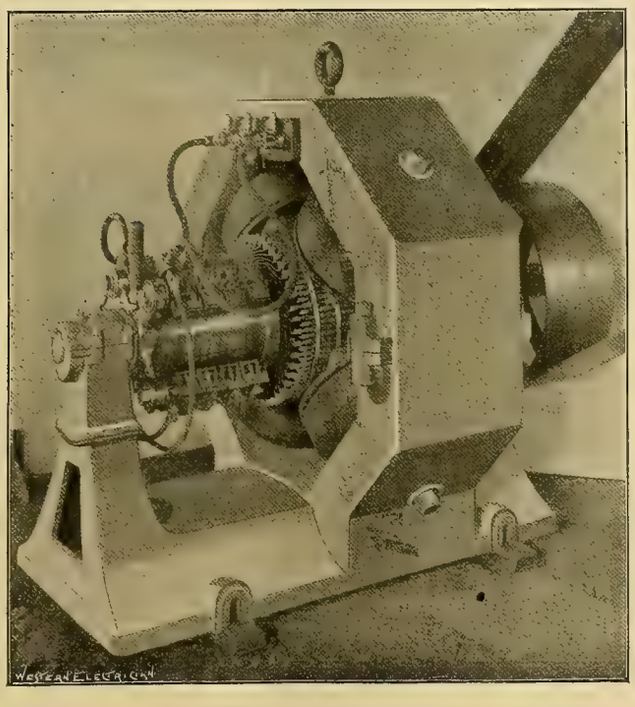

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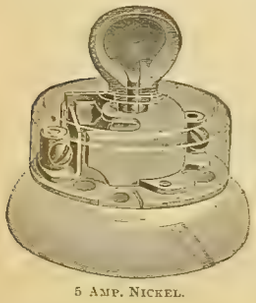

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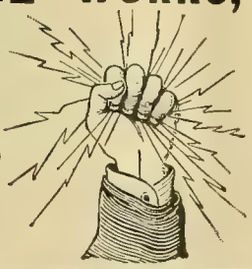

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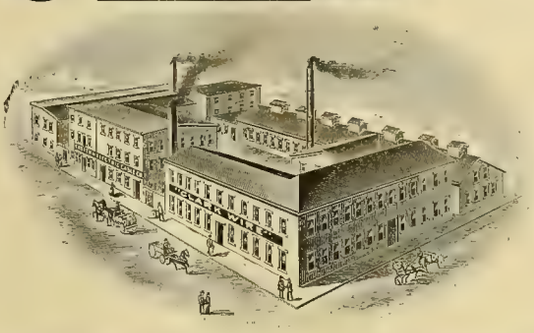

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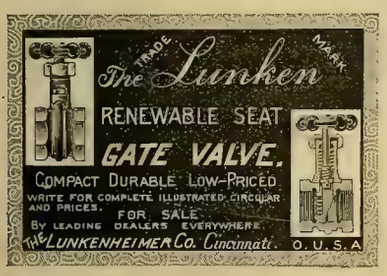

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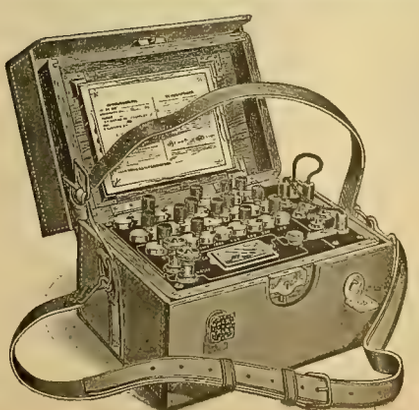

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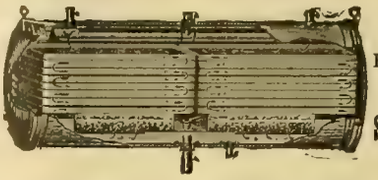

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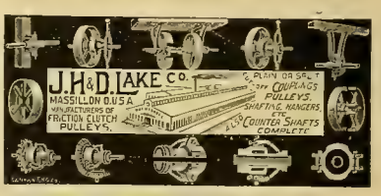

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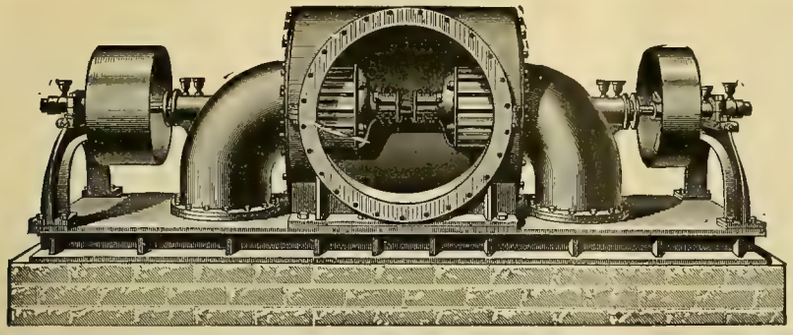

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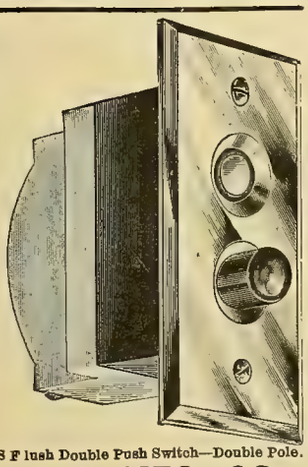

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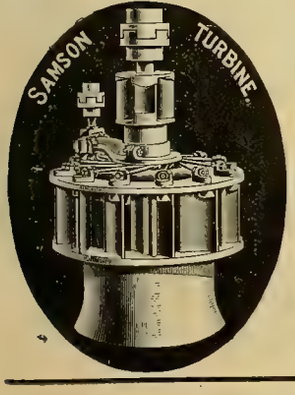

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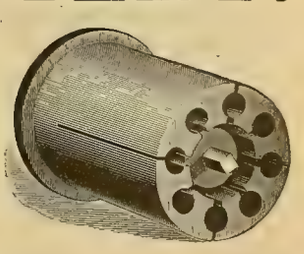

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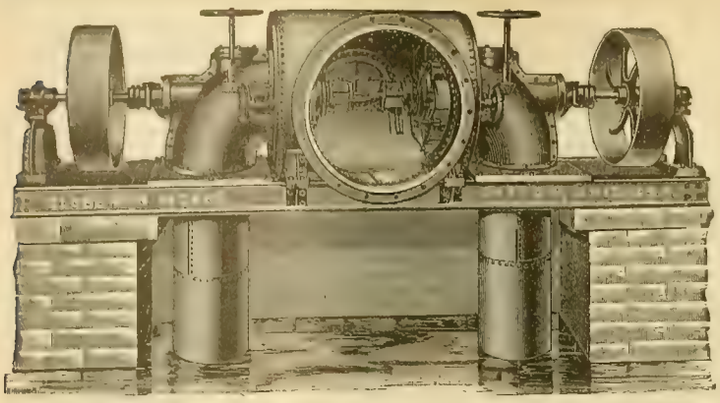

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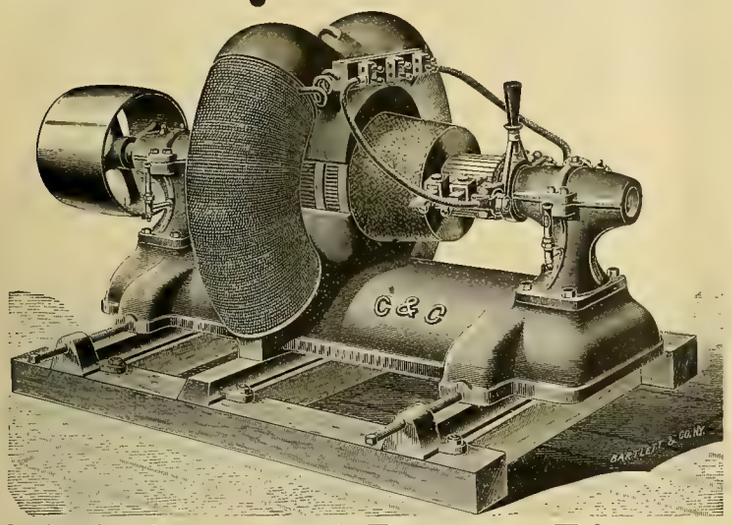

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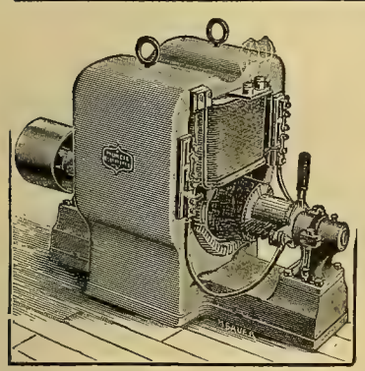

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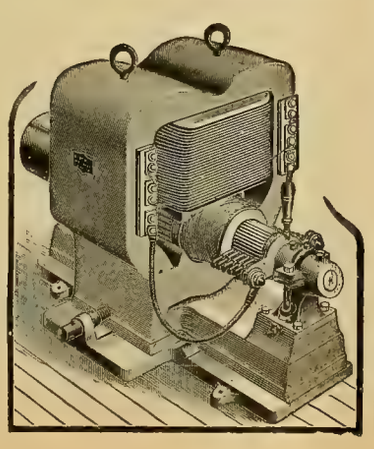

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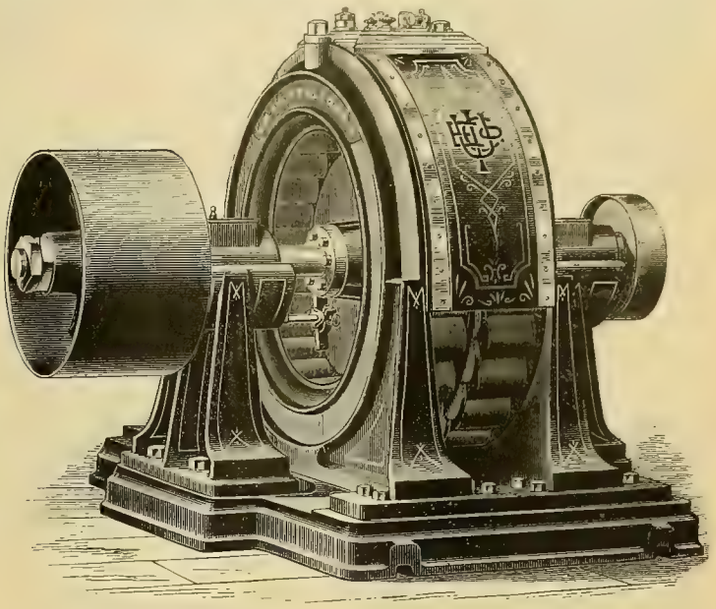

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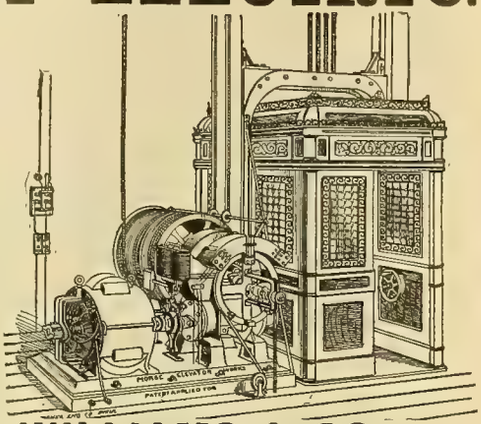

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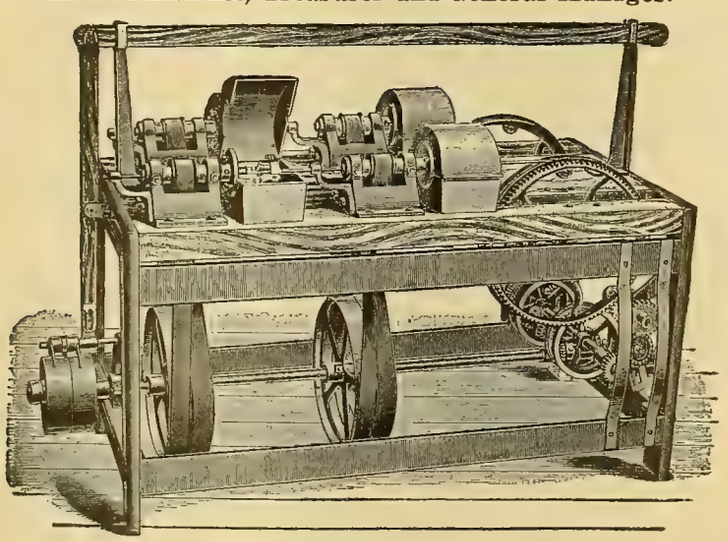

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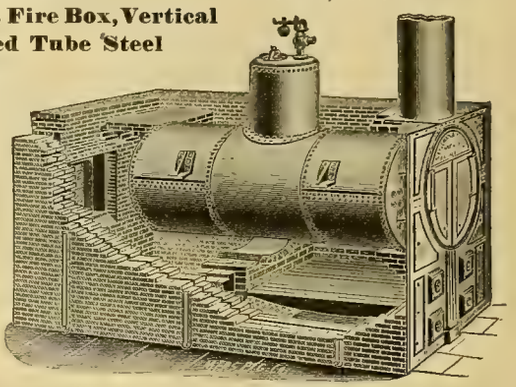

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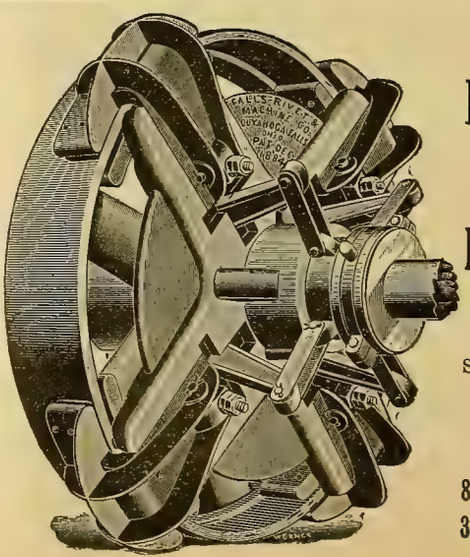

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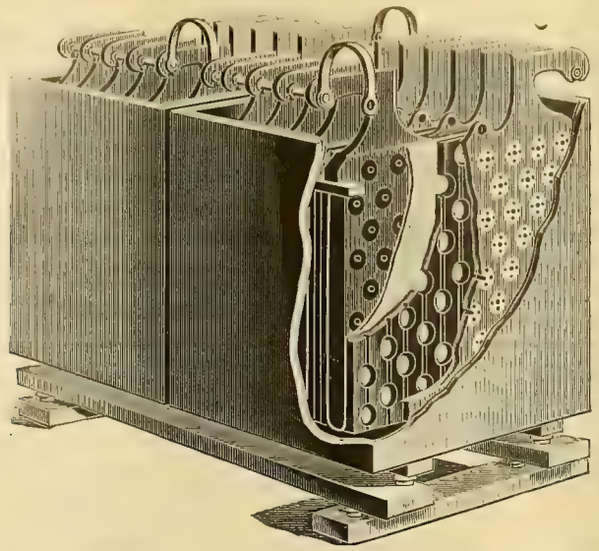

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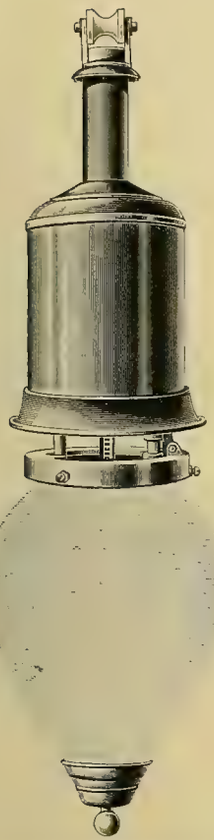

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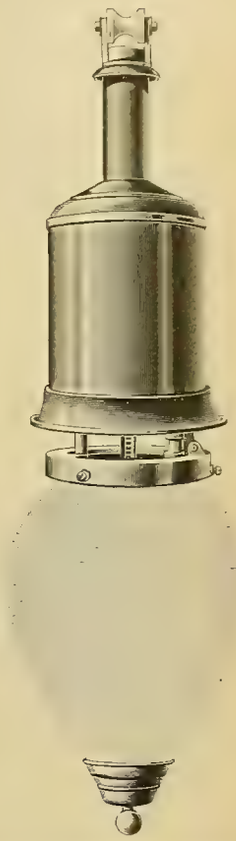

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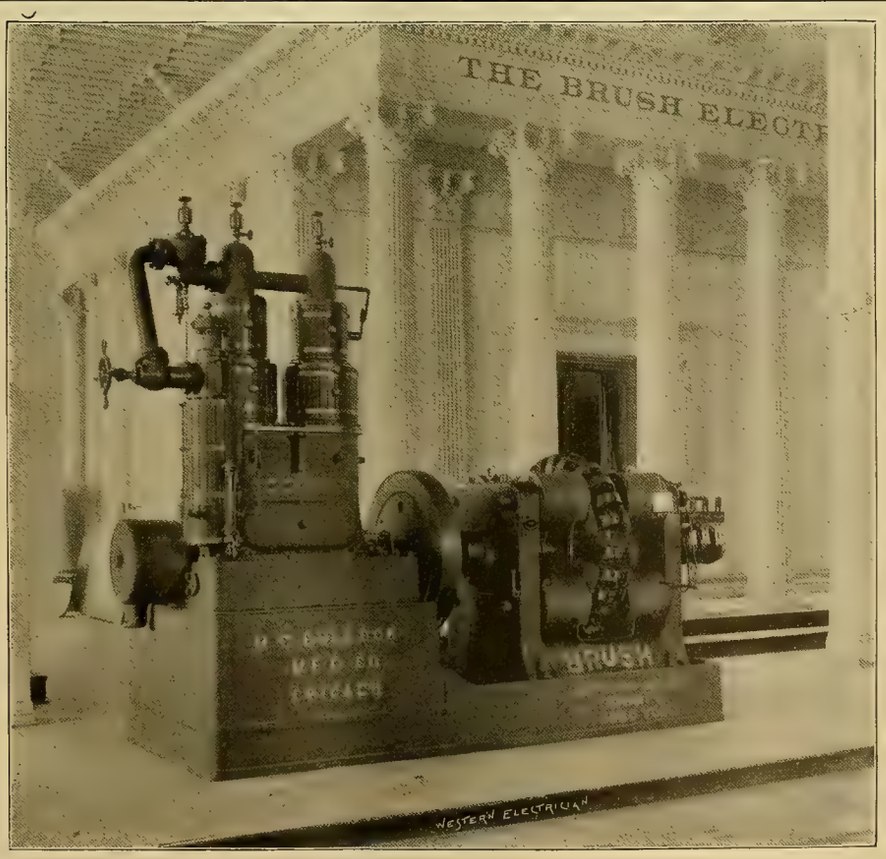

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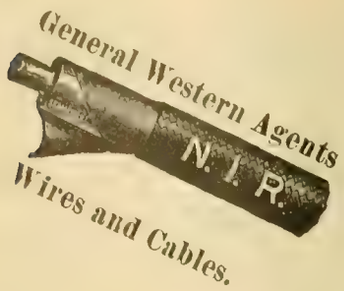

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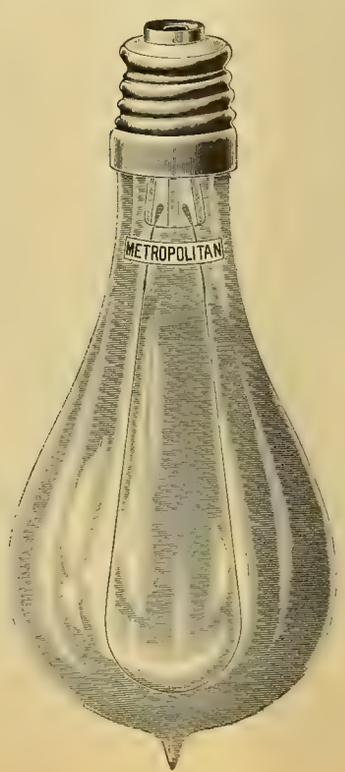

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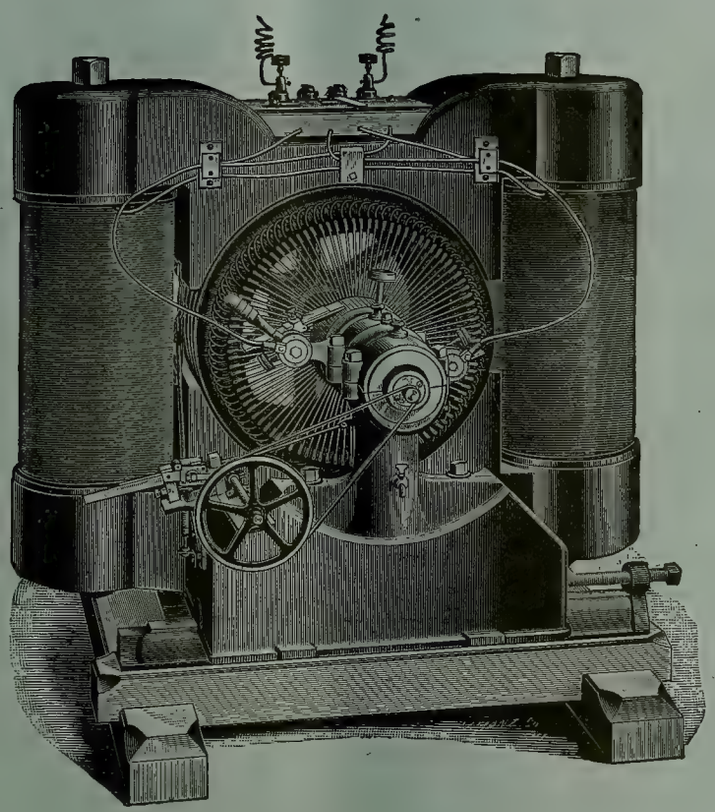

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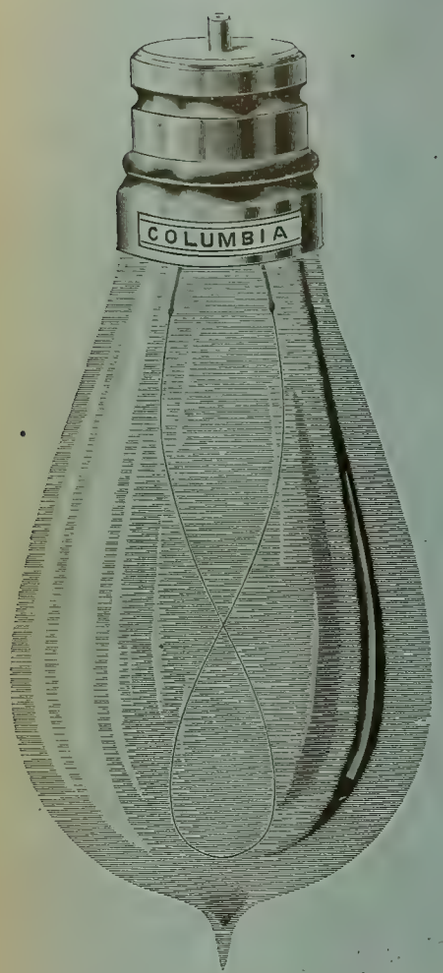

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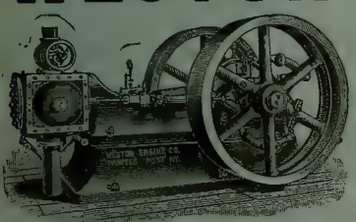

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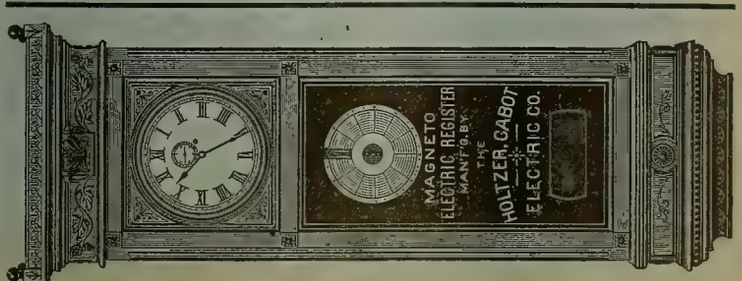

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ARE YOU PAYING TOO MUCH FOR YOUR CANDLE?

First Cost Does Not Decide It.

THE
"AMERICAN" LAMP
IS "LONG LIVED."

St. Louis, January 10, 1892.

GRAND BILLIARD HALL.

In reply to your letter inquiring about service of your lamps, I am compelled to acknowledge them to be *the best lamp I have ever used* for life and brilliancy. I put in one hundred of your 24 c. p. lamps on July 8, 1891, and have quite a number of them in use yet. My average run is 10½ hours per day for seven days a week. These lamps still maintain their candle power so well that it is almost impossible to distinguish the old from the new lamps. Respectfully,

C. A. COLLETT, *Engineer.*

THE
"AMERICAN" LAMP
IS "EFFICIENT."

After using your lamps for three months, we find in them *more than you represented* as to their life and efficiency. In proof of their efficiency we would say, we are easily carrying 276 of your 16 c. p. lamps on our dynamo, Edison pattern, while the estimated capacity of same is only 225 16 c. p. lamps at 101 volts. We are also pleased to say that, notwithstanding the overload, we are not troubled with heating of commutator or bearings, which we know to have been the case before your lamps were used on this dynamo. We will soon place another order with you. Yours truly,

St. Louis Refrigerator & Wooden Gutter Co.

THE
"AMERICAN" LAMP
IS "QUITE SATISFACTORY."

Municipal Electric Lighting and Power Co.,
Offices, 511 N. Fourth St.

St. Louis, September 14, 1892.

During the past year we have used many of your lamps and have found them *in all particulars quite satisfactory*, which you no doubt have understood because of the continuance of the orders.

Yours truly,

JAS. I. AYER, *General Manager.*

THE
"AMERICAN" LAMP
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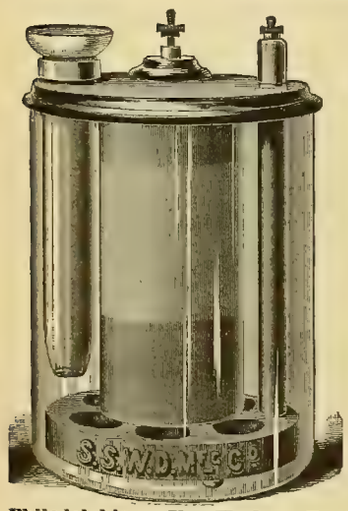

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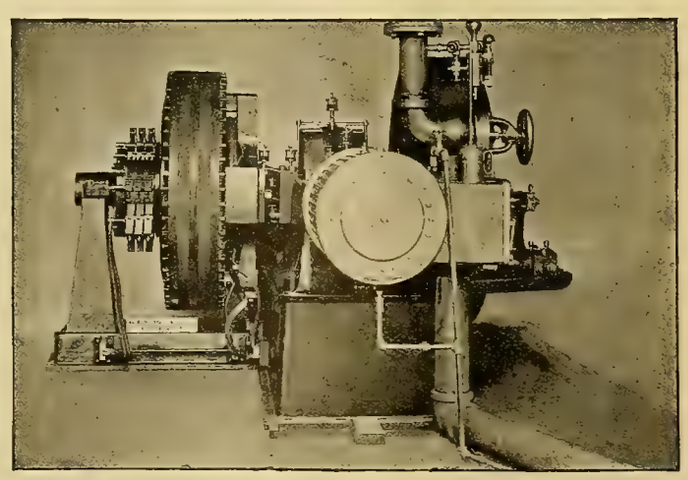

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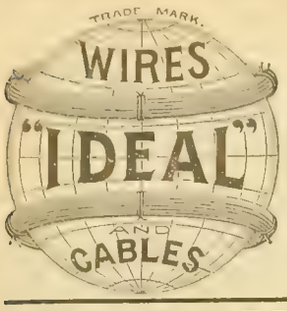

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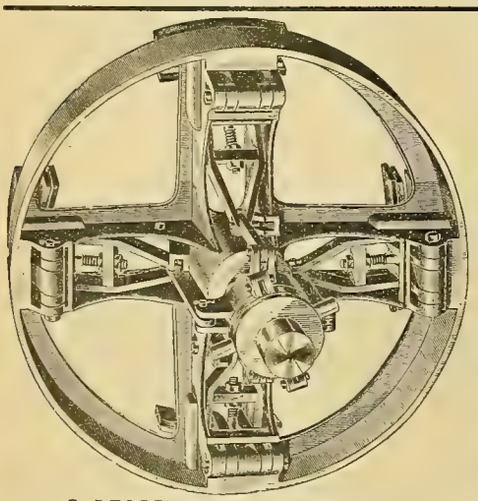

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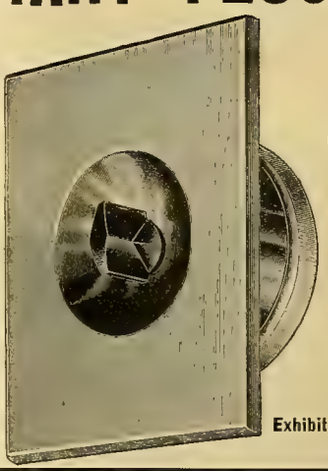

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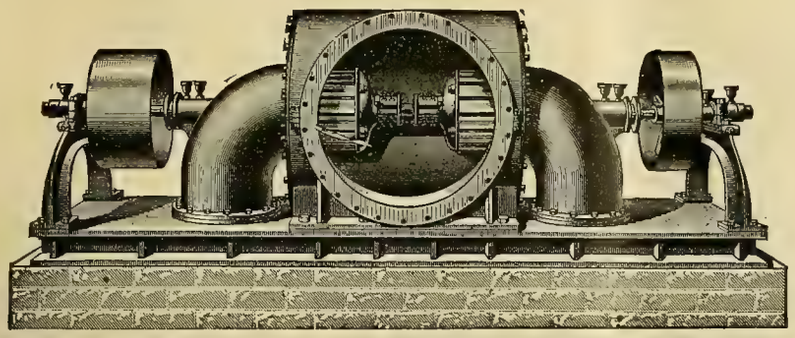

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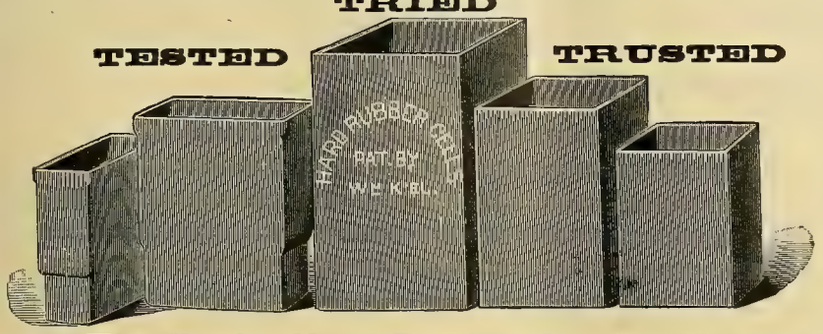

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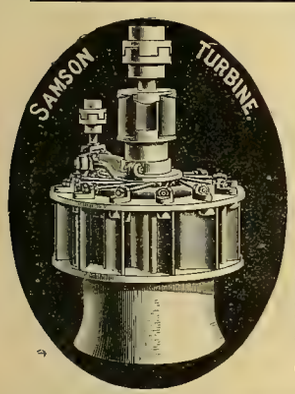

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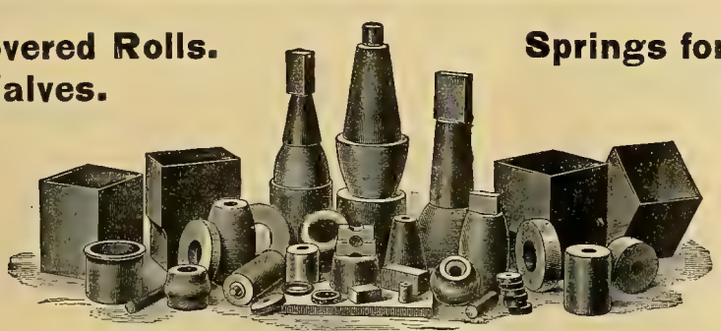

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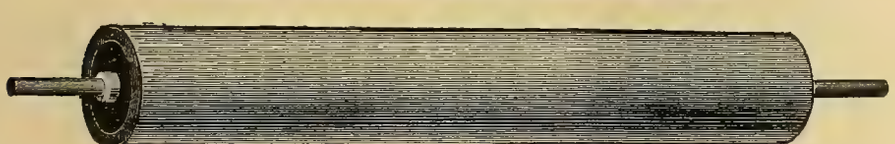

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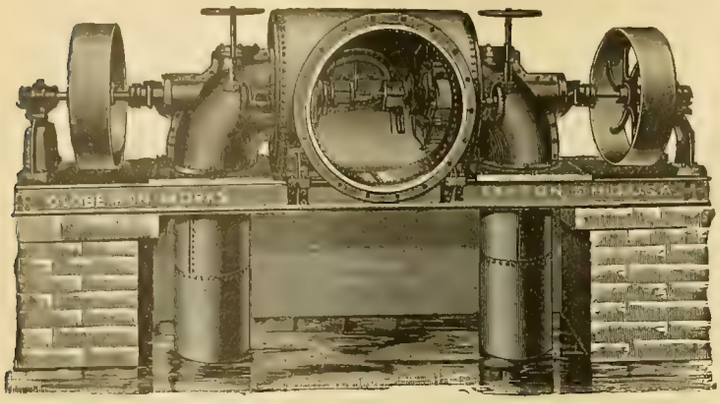

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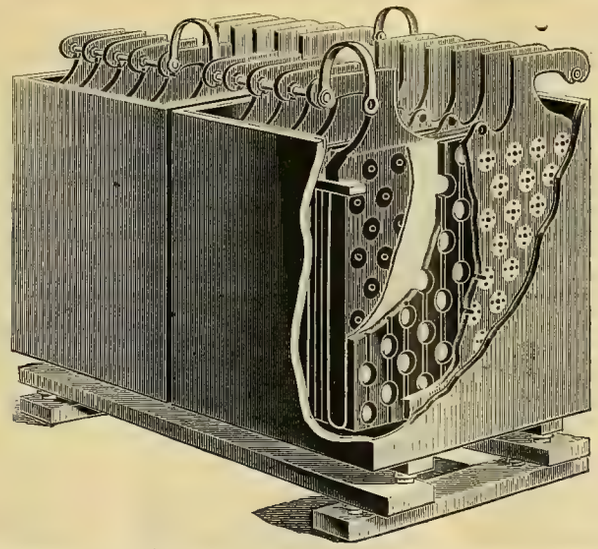

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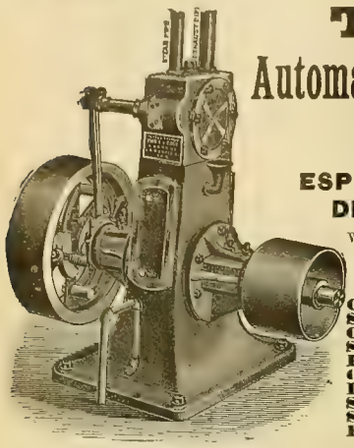

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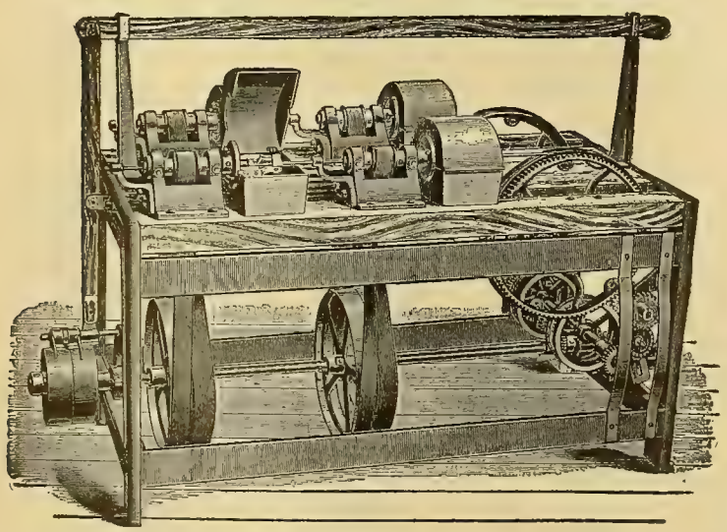

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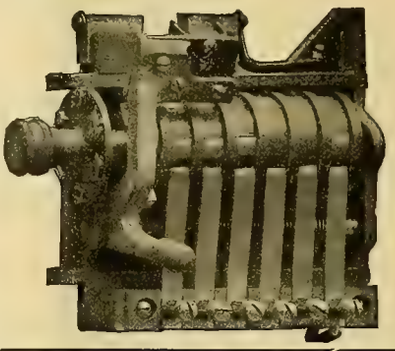

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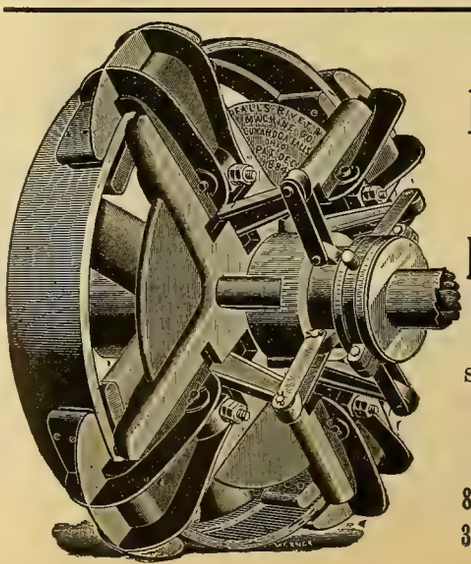

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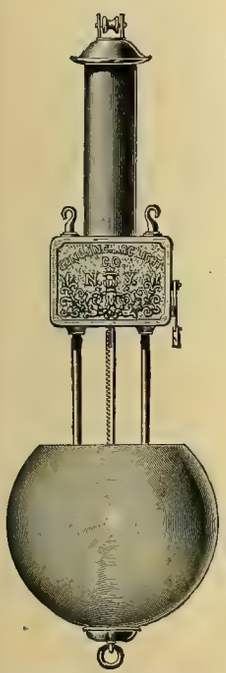

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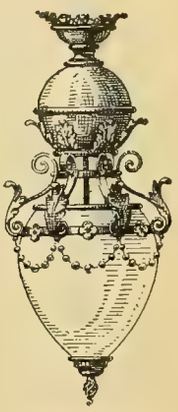

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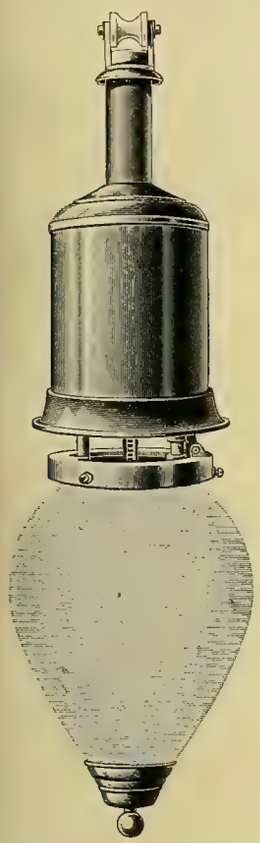

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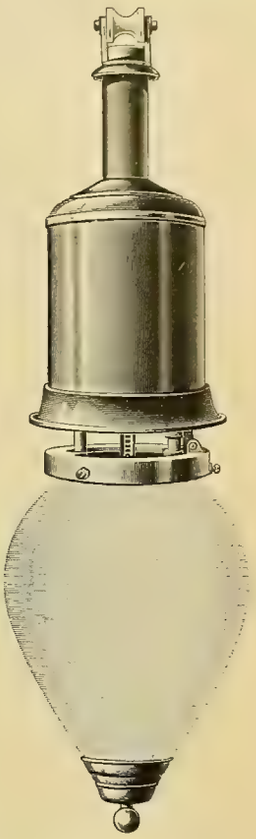

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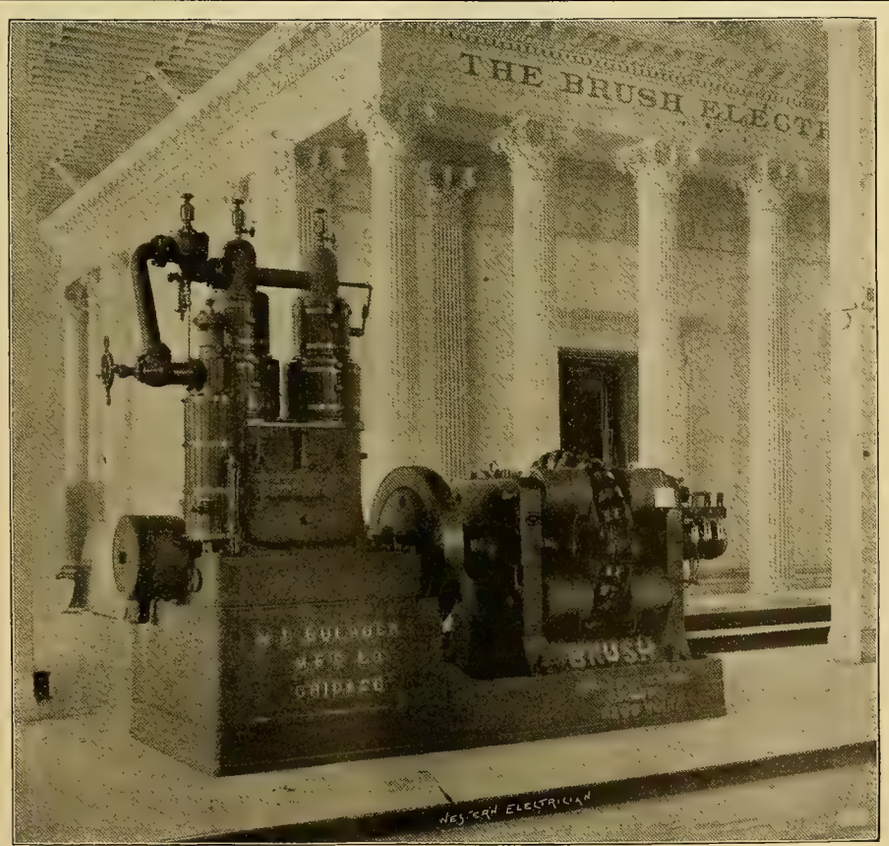

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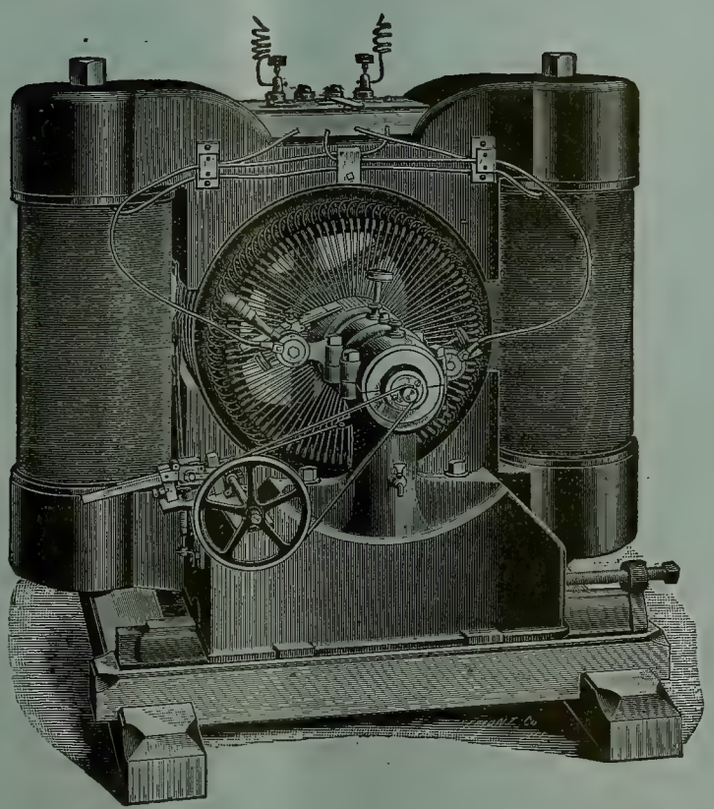

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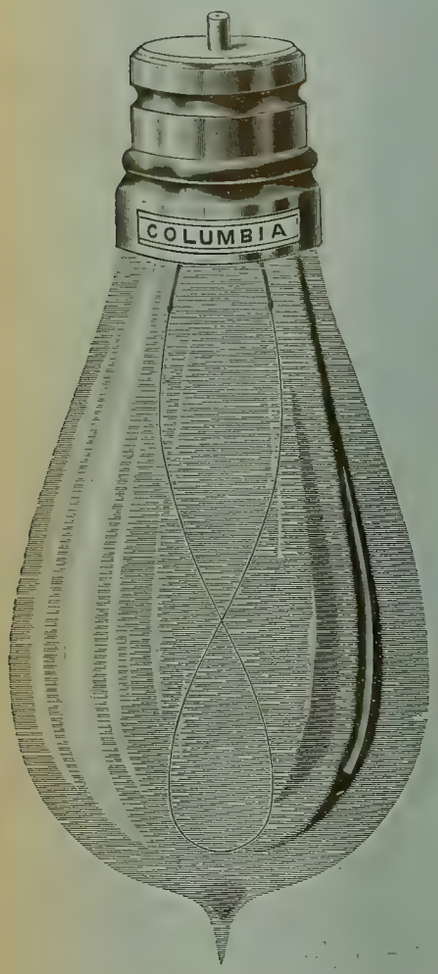

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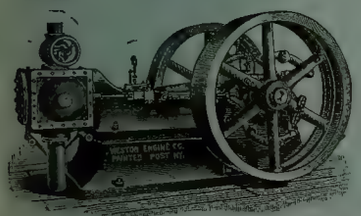

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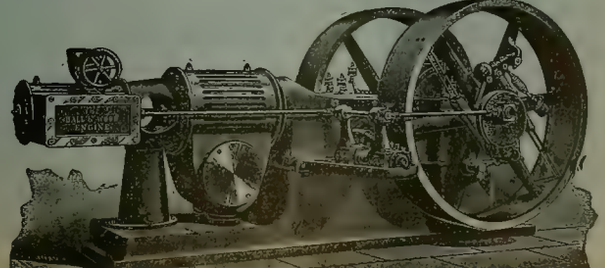

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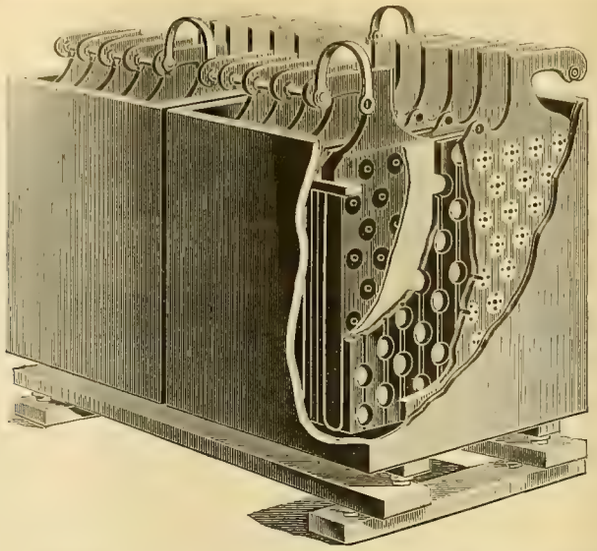

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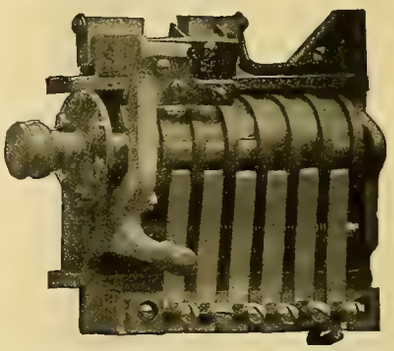

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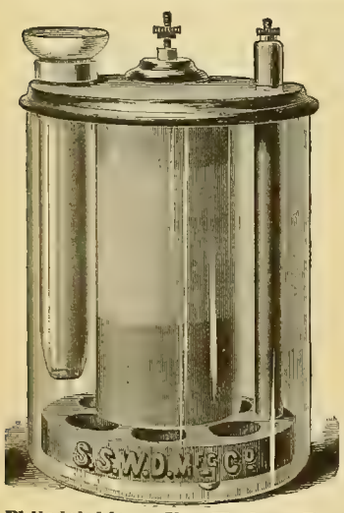

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I beg to acknowledge receipt of yours of the 25th ult., asking about what experience we have had with the Okonite wire furnished for Fire and Police circuits at the World's Fair Grounds. I note that you received a letter from me stating that I knew nothing about this wire. The letter to which you refer was written by my Assistant during my absence, and the wire which you furnished was all used up before he had anything to do with this portion of our work.

The wire to which you refer was used nearly all, or wholly, for underground work in ducts, which were much of the time filled with water and ice, and I have never had any report of any trouble on these circuits due to the insulation of it. To the best of my knowledge they have worked satisfactorily all the time.

Yours very truly.

R. H. Pierce

Electrical Engineer.

Geo. A. McKinlock, President & Treasurer

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Chicago, Dec. 12, 1893.

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Jackson Park, Chicago.

Dear Sir:-

We have your valued favor of the 7th inst., and beg to thank you for the information contained therein in regard to your experience with the Okonite wire furnished you for Fire and Police Circuits at the World's Fair Grounds.

We look upon your testimony as of more value than a bushel of medals, and beg to assure you that we appreciate your kind expressions.

Yours truly,

Central Electric Co.

Geo. A. McKinlock

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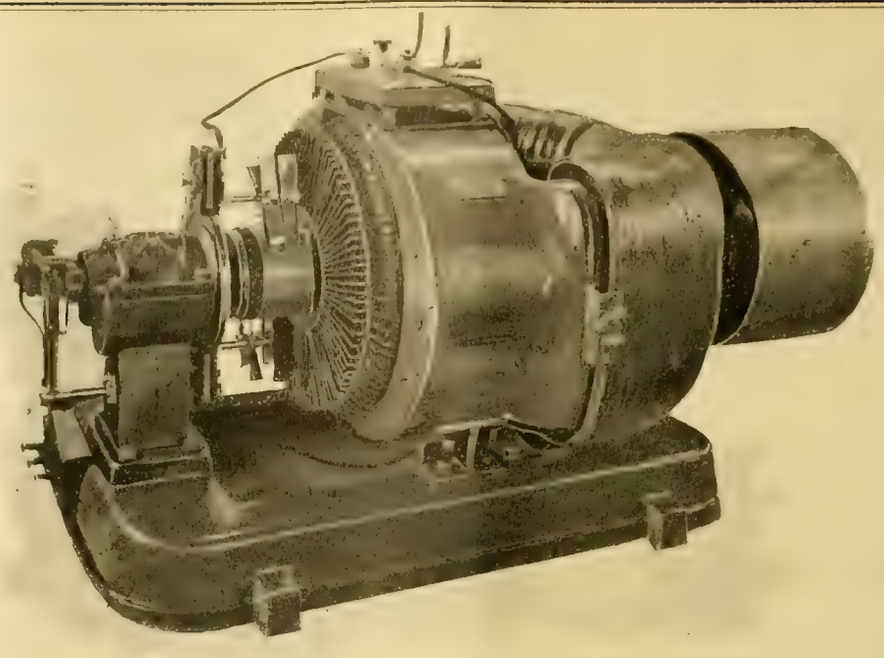

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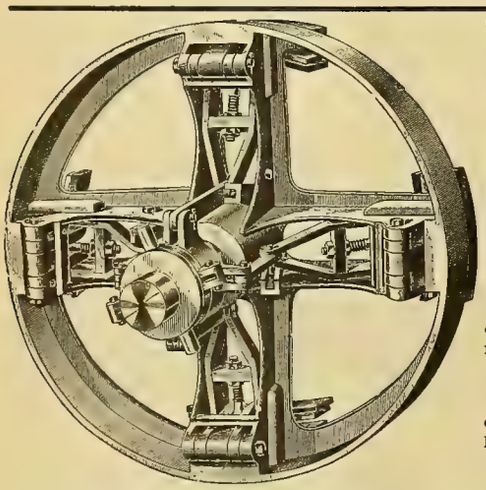

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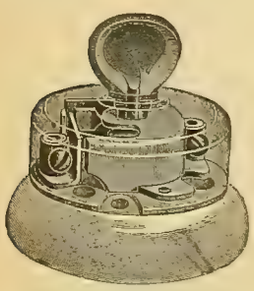

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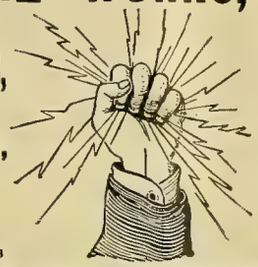

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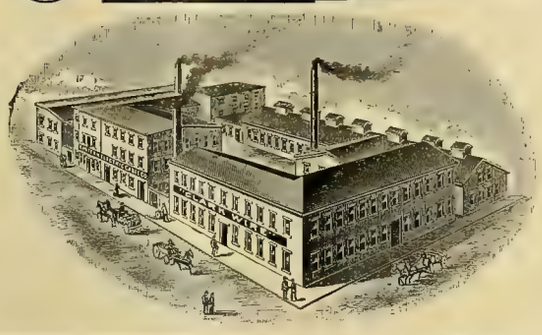

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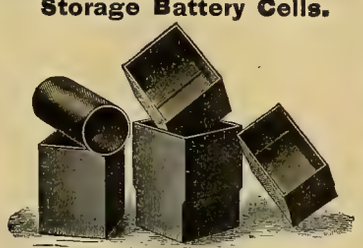

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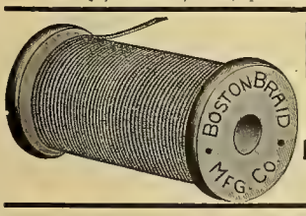

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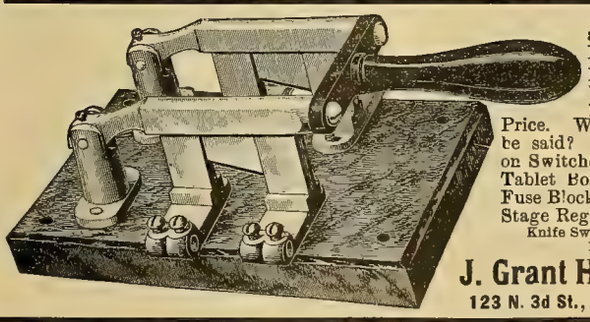

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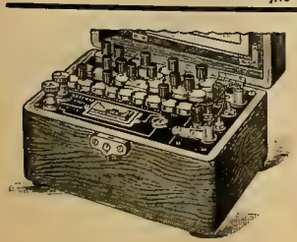

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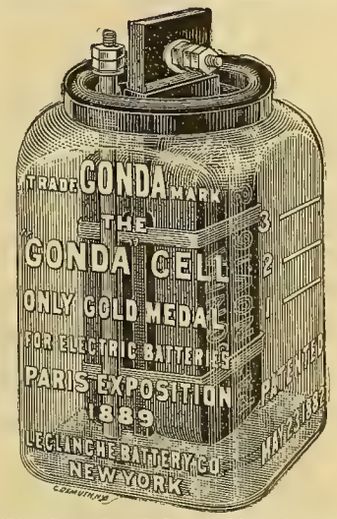

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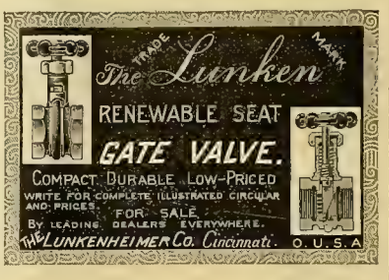

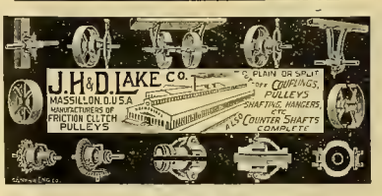

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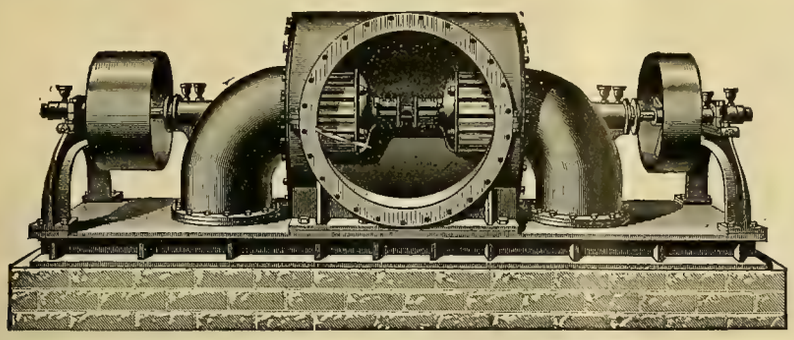

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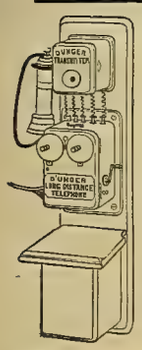

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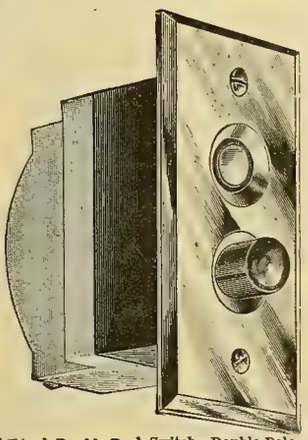

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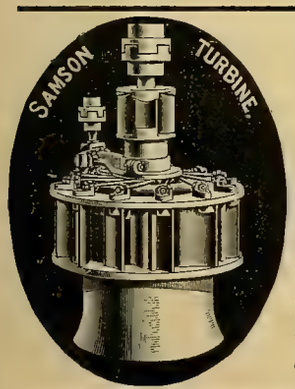

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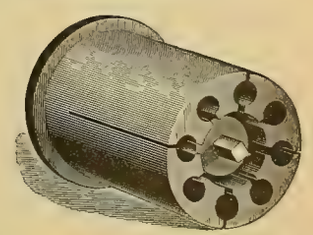

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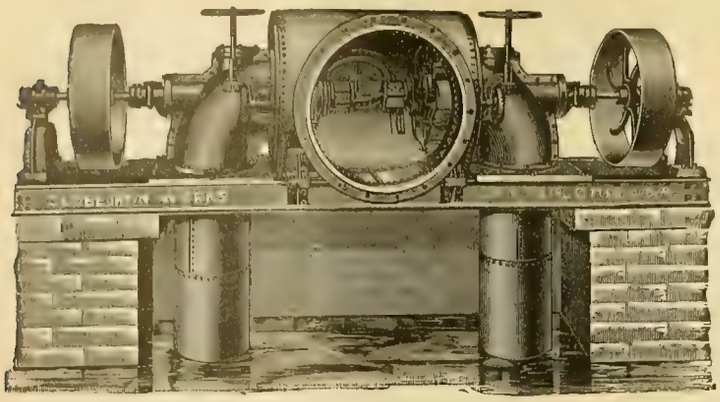

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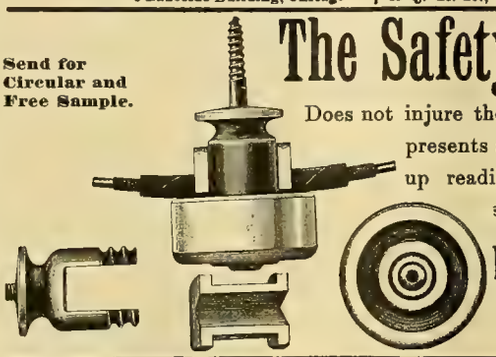

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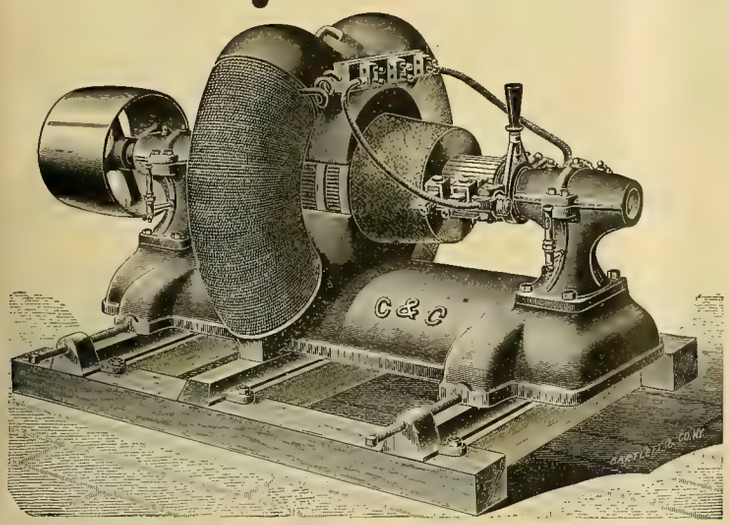

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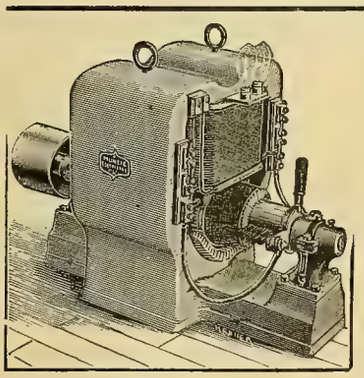

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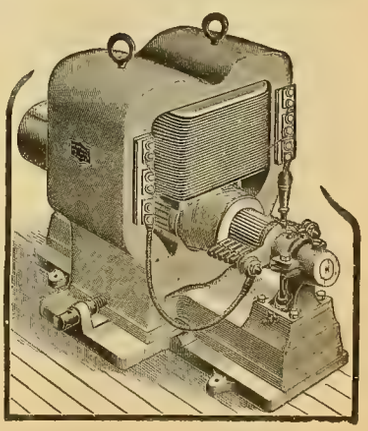

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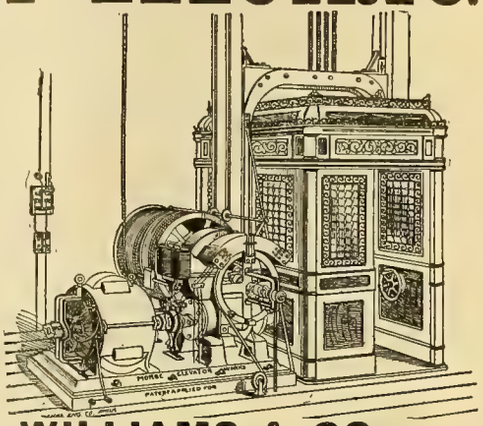

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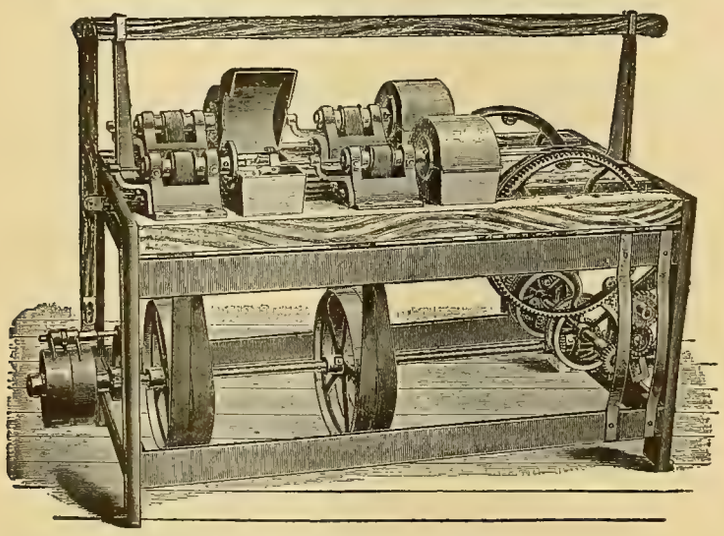

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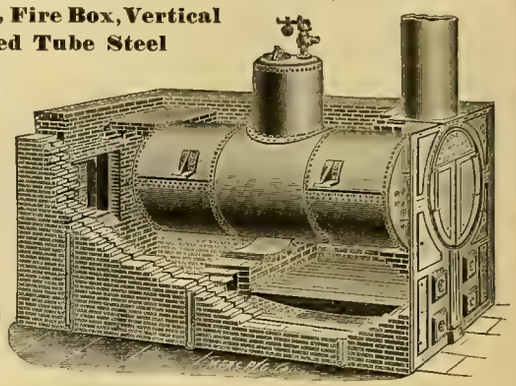

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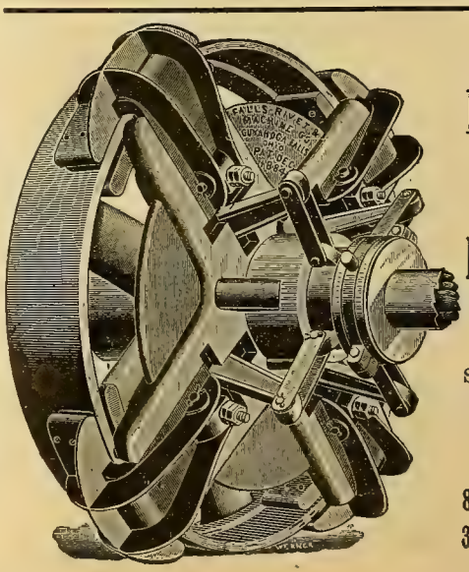

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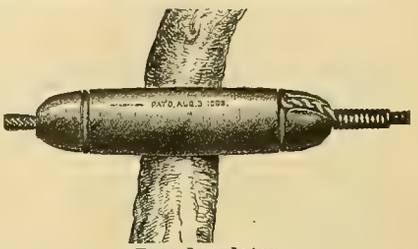

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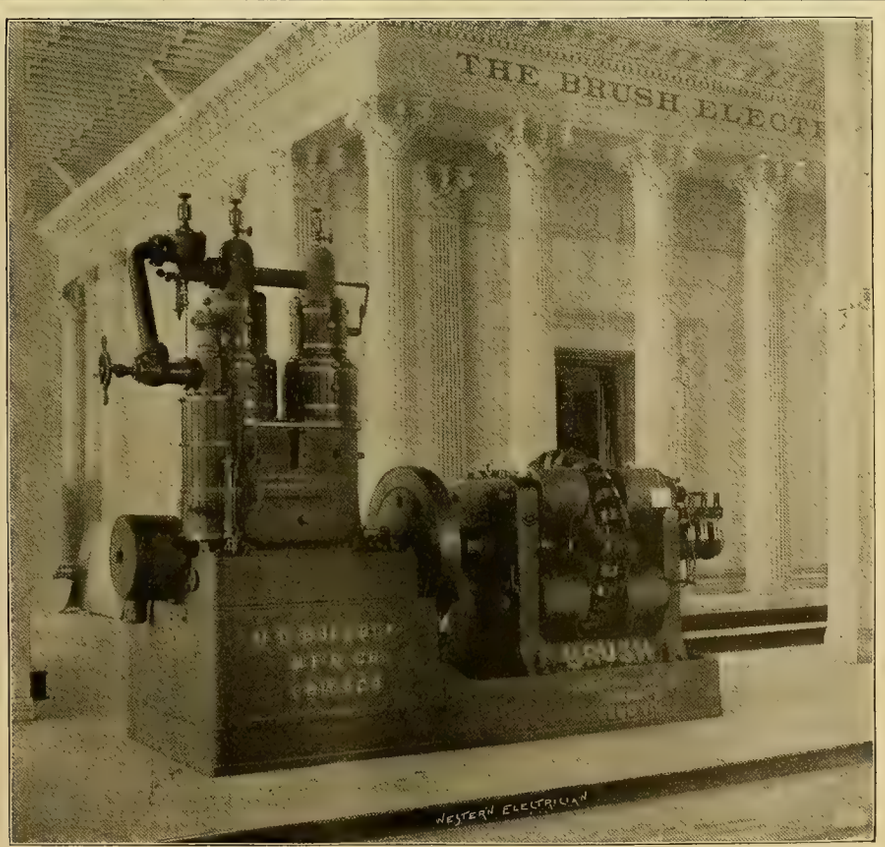

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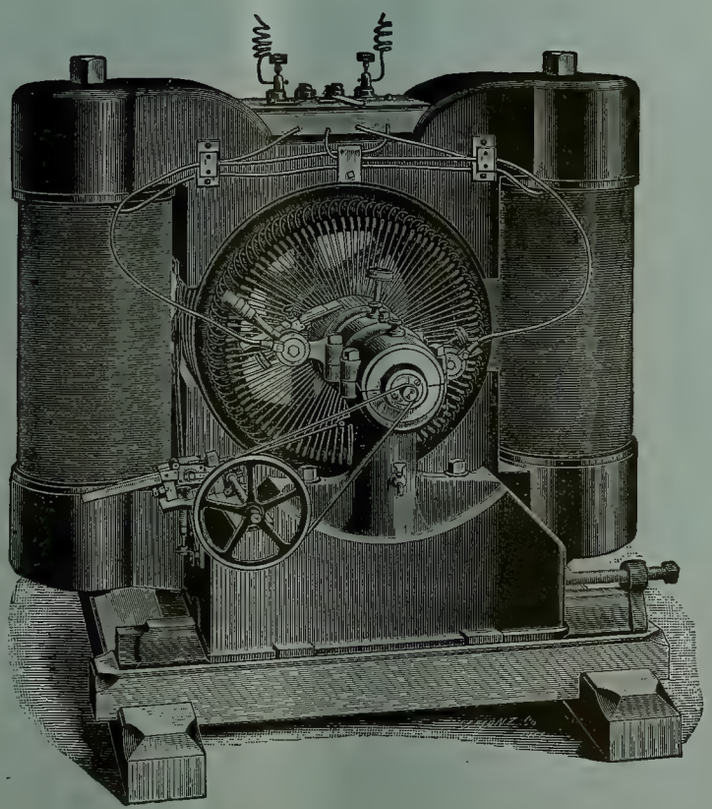

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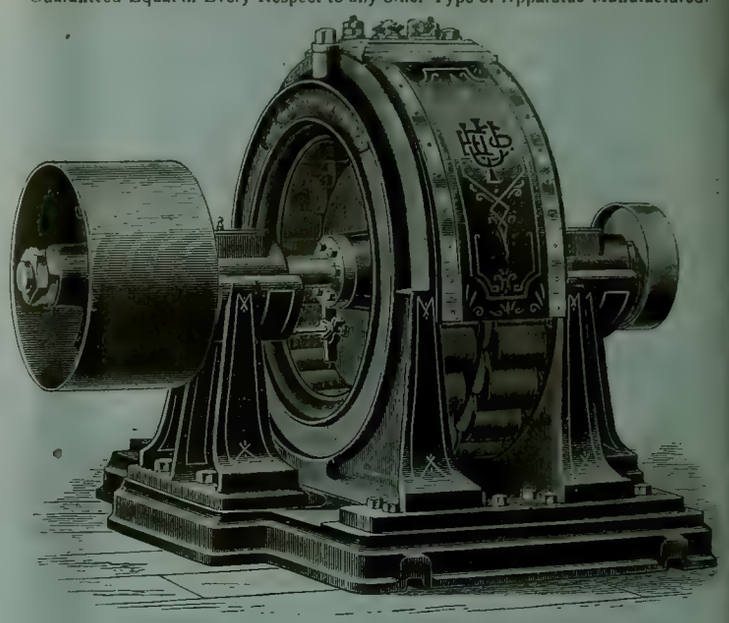

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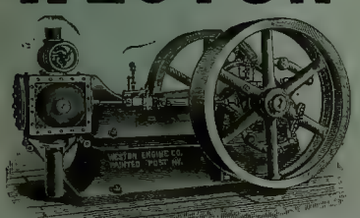

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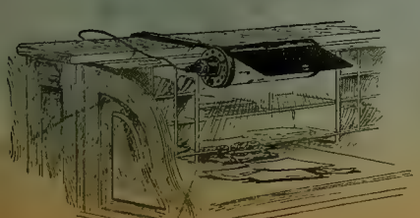

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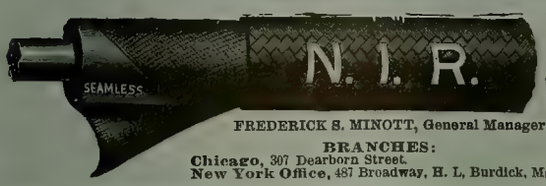

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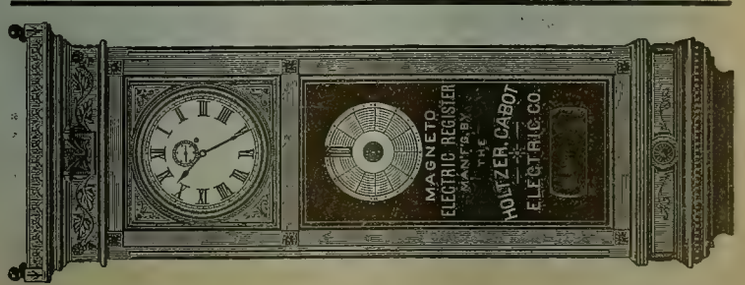

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Buckeye Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
New York and Ohio Co.
New York Electric Co.
Sunbeam Inc. Lamp Co.
Taylor, Dee & Mack.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.

Magnet Wire.
(See Insulated Wires.)

Mica.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Brush Electric Co.
C. & C. Electric Co.
Ford-Washburn Storel. Co.
Fort Wayne Electric Co.
General Electric Co.
Gregory, Chas. E. Co.
Royal Electric Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Waddell-Entz Company.
Westinghouse El. & Mfg. Co.

Paints,
Standard Paint Co.

Patents.
Rosenbaum, Wm. A.
Stocking, E. B.

Phosphor Bronze.
Phosphor Bronze Sm. Co., Ltd.

Platinum.
Baker & Co.

Porcelain.
Empire China Works.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electric Appliance Co
Metropolitan Electric Co.

Rheostats.
General Electric Co.
Washington Electric Co.

Sal Ammoniac.
Innis & Co.
Klipstein, A.

Second-Hand Electrical Machinery.
Beggs, J. E. Mach. & Sup. Co.
Gregory, Chas. E. Co.
Rose Elec. Lt. Supply Co.

Silk Braid.
Boston Braid Mfg. Co.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co. Incorp.
Whitney Elec. Instrument Co.

Steam Heating.
Webster & Co., Warren.

Steam Pumps.
Worthington, Henry R.

Storage Batteries.
Bradbury-Stone Elec. S. Co.
Electric Storage Battery Co.
Pumpelly-Sorley S. B. Co.

Stoves, Electric.
Consolidated Car-Heating Co.

Street Cars.
Brill, J. G. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.

Telegraph Apparatus.
Central Electric Co.
Electric Appliance Co.
Electric Selector & Signal Co.
Greely & Co., The E. S.
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

Telephones,
D'Unger Elec. Tel. Mfg. Co.
Western Electric Co.
Western Tel. Const. Co.

Transformers.
Royal Electric Co.
Stanley Electric Mfg. Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Tools.
Lunkenheimer Co., The.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Stilwell & Bierce Mfg. Co.

Universities.
Armour Institute.
Correspondence School of Technology.
Institute of Technology.

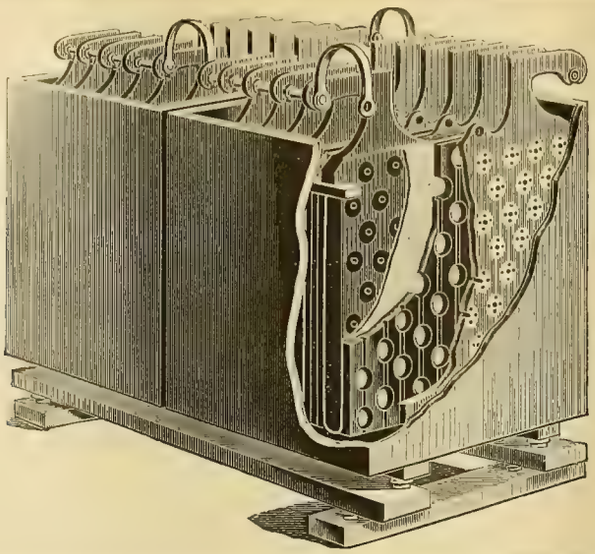
Valves.
Lunkenheimer Co., The.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.

Wire, Bare.
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons' Co., J. A.
Spruance, D. C.
Taylor, Dee & Mack.



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Cells from 10 to 5,000 amp. hours Capacity.

Central Station and Traction Cells a Specialty.

BATTERIES FOR ISOLATED LIGHTING AND POWER PLANTS.

Catalogue gives FACTS and FIGURES.

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Drexel Building,
PHILADELPHIA, PA.

CHICAGO OFFICE, 302 Owings Bldg.
CHAS BLIZARD, Gen'l Sales Agt.

Important to Lighting Stations!

OUR NEW:

ALTERNATING CURRENT INDICATORS

Are now ready. Before purchasing elsewhere send for our Supplementary Catalogue which contains the prices and description of the above instruments, and also a list and prices of other *new instruments* of our manufacture.

Whitney Electrical Instrument Company,

146 Franklin Street, BOSTON, MASS.

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Cincinnati, Ohio, Nowotny Electric Co.
Halifax, N. S., John Starr Son & Co., Ltd.
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Awarded First Premium at the World's Fair.

Excellence of Material and Construction. High Insulation,

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Reliability and Durability Under the Most Exacting Conditions.

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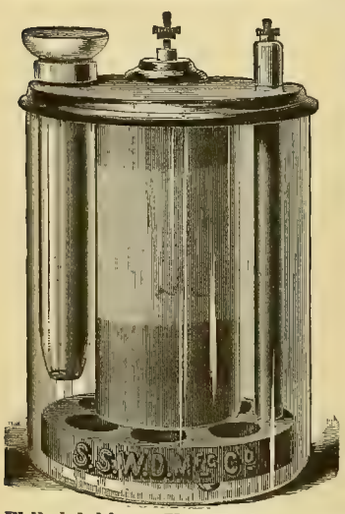

THE PARTZ Acid Gravity Battery.

(Patented.)

The Highest Voltage and Most Constant Open Circuit Battery.

Use the Partz Sulpho-Chromic Salt.

(Patented.)

No handling of Fluid Acids or Mixing of Chemicals.

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Our Exhibit at the Chicago World's Fair is in the West Gallery of Electricity Building.

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Philadelphia, New York, Boston, Chicago, Brooklyn, Atlanta

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"THE HELIOS"

SPECIAL ALTERNATING ARC LAMP

Can be run three in series from 105 volt secondary circuit.

STANDARD ALTERNATING ARC LAMPS

Can be run in multiple from 50 or 100 volt secondary circuits by Spencer Economy Coils.

No Special Transformers Necessary. No Dead Resistance Required. No Change of Wiring.

SPECIAL NOTICE.

Helios Carbons will be sold only with the Helios Lamp. The Helios is the only lamp that has a legal right to use the reflector plate between the standards, without which one-half of the light is wasted.

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Eastern Penn. and Southern N. J. Agency:
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THE ANSONIA ELECTRIC CO.,
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ST. LOUIS ELECTRICAL SUPPLY CO.,
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STREET LIGHTING FROM ALTERNATING CURRENT DYNAMOS.

New Prices given on Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters

And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.

This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.

OUR SERIES LAMPS

Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.

BERNSTEIN ELECTRIC COMPANY, 620 Atlantic Ave., Boston, Mass.

1894. FEBRUARY. 1894.

JANUARY

SU	M	TU	W	TH	F	SA
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

FEBRUARY

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

MARCH

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

APRIL

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

MAY

SU	M	TU	W	TH	F	SA
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JUNE

SU	M	TU	W	TH	F	SA
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

COMBINATION CALENDAR TABLET
COPYRIGHTED 1890 BY C. H. CANDLER

SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.
				1 (32)	2 (33)	3 (34)
4 (35)	5 (36)	6 (37)	7 (38)	8 (39)	9 (40)	10 (41)
11 (42)	12 (43)	13 (44)	14 (45)	15 (46)	16 (47)	17 (48)
18 (49)	19 (50)	20 (51)	21 (52)	22 (53)	23 (54)	24 (55)
25 (56)	26 (57)	27 (58)	28 (59)			

MOON'S PHASES. NEW MOON. 5th FIRST QR. 13th FULL MOON. 19th LAST QR. 27th

JULY

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

AUGUST

SU	M	TU	W	TH	F	SA
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

SEPTEMBER

SU	M	TU	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

OCTOBER

SU	M	TU	W	TH	F	SA
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

NOVEMBER

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

DECEMBER

SU	M	TU	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

DAYS IN FEBRUARY

When you Should Send Us Your Order For

ALL ELECTRICAL SUPPLIES.

Send for Catalogue if you have not one already.

For Sale Cheap.

600,000 pounds of Safety, Grimshaw, Okonite, and E. M. W. Rubber Covered Wire, varying in size from 0000 to 18 B. & S. This wire has been purchased by me from the World's Fair, and must be sold in Sixty Days.

The wire has been used UNDER COVER, IS AS GOOD AS NEW, and will be sold CHEAP FOR CASH.

ADDRESS,

D. C. Spruance,

Auditorium Hotel, - CHICAGO.

Announcement.

THE BUCKEYE ELECTRIC COMPANY, Manufacturers of the high grade and favorably known "BUCKEYE" incandescent lamp, take pleasure in announcing to their friends and customers and the trade generally, that on January 23, 1894, Hon. A. J. Ricks, Judge of the United States Circuit Court, at Cleveland, Ohio, dissolved the injunction which had been previously obtained by the General Electric Company against this Company, and in so doing used the following language:

"Did the defendant in good faith act upon the complainants' limitation of the life of their patent, and was it so induced to act by the conduct of the complainants, and is it now in such relation to the complainants as estops them from denying that their conduct induced the defendant to make its investments and act as it has set forth in its motion now under consideration?

"The circumstances under which the defendant began its enterprise of manufacturing Electric Incandescent Lamps: The different stages in the progress of its development, and the reasons inducing it to increase its capital are fully set forth in its motion and as hereinbefore recited.

"Without deciding how far others not similarly situated had the right to rely upon such conduct on the part of the complainants or without passing upon the question, of how far the public generally acquired rights under the complainants' proceedings in the patent office by which they limited the life of their patent, it is sufficient to find under this motion, that the defendant by reason of the circumstances particularly set forth in its motion did rely upon the complainants' conduct, and had a right to be, and was in fact influenced thereby.

"If I am in error as to this conclusion no great harm can result to the complainants, and their right to contest as to other infringers not able to show such meritorious claims to estoppel, as this defendant has established can be asserted without prejudice from this decision."

The lamps manufactured by this Company are therefore "LAWFULLY MADE" and we guarantee the fullest protection in every respect to all purchasers or users. We are now ready to fill orders with care and promptness.

The Buckeye Electric Company of Cleveland, Ohio.

CHICAGO OFFICE, 753 Monadnock Building. NEW YORK OFFICE, 49 Dey St.

TRADE MARK. WIRES "IDEAL" AND CABLES

"IDEAL" INSULATED COPPER WIRE.

Best Substitute for Rubber.

HIGH INSULATION. LONG LIFE. LOW COST.

— MANUFACTURED BY —

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AGENCIES:
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VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF

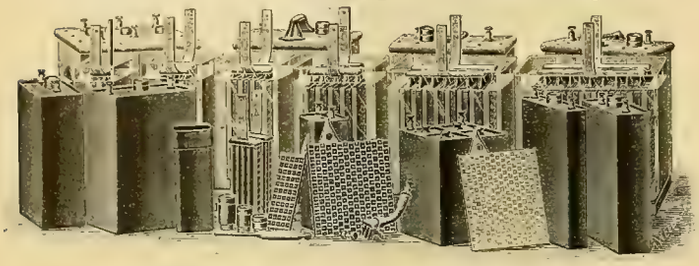
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

The "Ideal" Storage Battery

For all Classes of Work where Light and Power are Required.



Thousands in use all over the country.

Bradbury-Stone Electric Storage Co.,

Boston Office, 542 Exchange Bldg. **LOWELL, MASS.**

PERFECT MICANITE INSULATOR REGISTERED

Sole Manufacturer of Micanite Plates, Commutator Segments, Rings Washers, Tubes, Troughs, Taper Rings, Cloth, Paint, etc.,

FOR ELECTRICAL INSULATION.

MICA INSULATOR CO.

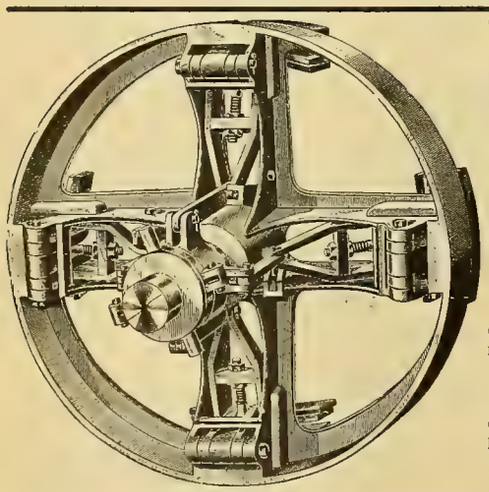
218 WATER STREET, NEW YORK.

PUMPELLY-SORLEY STORAGE BATTERY.

- Made Electro-Chemically.
- No Applied Active Material or "Paste."
- Plate made from one integral piece of rolled lead.
- No joints; no solder.
- High efficiency, capacity and durability guaranteed.
- Lighting plants and central station auxiliaries installed.
- Portable cells, all sizes.

Pumpelly-Sorley Storage Battery Co.

170 South Clinton Street, CHICAGO.



THE

EWART FRICTION CLUTCH.

Especially designed for heavy duty at high speed, and fully guaranteed.

Complete Power Equipment for Electric Plants.

The Standard Water-Tube Safety Boiler.

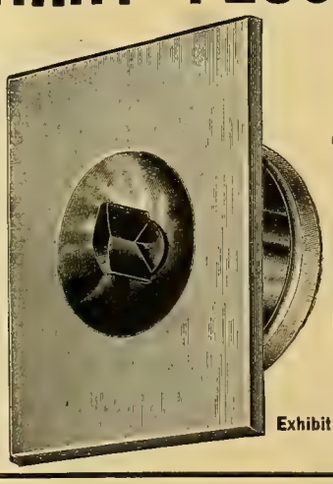
Coal and Ashes Handling Machinery.

MANUFACTURED BY

LINK-BELT MACHINERY CO.,

Engineers, Founders, Machinists. CHICAGO

HART FLUSH SWITCHES.



5 and 10 Ampere Single Pole.
10 Ampere Double Pole.
10 Ampere Three-way.

The Only Snap Switch that has

PROVEN A SUCCESS.

For Sale by All Supply Houses.

THE HART & HEGEMAN MFG CO.,

HARTFORD, CONN.

Exhibit at the World's Fair, Section S, Space 5, Southwest Gallery Electricity Building.

A NEW BOOK.

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 30,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE $1.00.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

Litigation! Litigation!

When the General Electric Company was formed by the absorption of the Thomson-Houston, the Edison General Electric and other companies, it inaugurated, for the express purpose of crushing out all competition, a policy of intimidation and costly litigation towards those users of electric machinery who had on account of superior quality of apparatus, preferred to purchase from competing companies. The officers of the Westinghouse Electric and Manufacturing Company were informed two years ago that an offer to join the Trust was open to them for a short period, on a certain basis of valuation, which basis was simply absurd. At that time it was intimated that if the offer was not accepted, a course would be adopted that would prevent the securing of orders, but in this latter particular the purchasers of electrical apparatus have decreed otherwise, as the events of the past two years have shown. The Trust seems to have learned but little by experience for it has just started a series of suits against users of competing apparatus and parties who have proposed to purchase from other manufacturers. The Westinghouse Electric and Manufacturing Company defends all of its customers in the following terms: "The company shall, at its own cost and expense, defend any and all suit or suits that may be instituted by any party against the purchaser for the alleged infringement of a patent or patents, when such alleged infringement shall consist in the use of any apparatus, machinery or device, or parts thereof, manufactured and sold by the company, for which the purchaser shall have made all payments then due, provided that immediate notice of the institution of such suit or suits be given in writing by the purchaser to the company, and that the purchaser shall permit the company, through its counsel, to defend the same, and shall give all needed information, assistance and authority to enable the company so to do, and thereupon, in case of an award of damages in such suit or suits the company shall pay such award. But the company shall not be bound to defend any suit or suits, nor to pay any damages therein, when the same shall arise by reason of the use of parts not furnished by the company."

STOPPER LAMPS. Were invented and patented by Sawyer and Man before the date of any of the inventions upon which the Trust now relies to secure to it a monopoly of the sale of incandescent lamps. These stopper lamps have been perfected and were used exclusively for the World's Fair lighting. Stopper lamps do not infringe the Edison patents, and they are cheaper and better than the Edison lamps.

FEEDER AND MAIN PATENT. By the use of our system of alternating current distribution and lamps, the use of the feeder and main feature of the Edison patent is not only unnecessary but leads to increased cost. All parties who are in any manner threatened with respect to this patent are advised to communicate with us immediately.

THREE WIRE PATENT. The alternating system distributing electricity renders the three wire feature an unnecessary complication. This company is prepared to furnish plans whereby better distribution of light can be had than is possible with the continuous current system and one hundred 110 volt lamps which are necessary with it.

"Purchase apparatus and repairs at Fair prices." It has recently been announced that the General Electric Company enjoys a trade of about four millions of dollars per annum for repairs, which it is claimed cannot be interfered with. This is certainly a monstrous sum of money to be paid out by the electric fraternity for repairs. We invite correspondence from any company which is paying anything toward these four millions, with a view of putting them in a position to get their repairs and renewals at reasonable rates, or what is still better, to get apparatus which will not require such enormous amount for repairs. We would also invite correspondence from all companies who are laboring under the onerous obligations of the famous contract form "D." We can help them also.

Westinghouse Electric & Mfg. Company,

PITTSBURGH, PA.

Do you ever experience difficulty in securing

INTELLIGENT EXECUTION

of your orders for electrical specialties and supplies? We think probably you do, as this is a very

COMMON COMPLAINT

among users of electrical material. We give this particular point our very closest

PERSONAL ATTENTION

and basing our statement on a combined practical experience in the business of fifteen years, feel justified in claiming that orders intrusted to our care receive the ***best possible attention.*** Try us.

ELECTRIC APPLIANCE COMPANY,

ELECTRICAL SUPPLIES. *242 Madison Street, CHICAGO.*

SOCKETS TO FIT 3/8-INCH PIPE.

We are now manufacturing Keyless Sockets to screw on 3/8-inch pipe for fixtures, street hoods, etc.

WE ALSO MAKE

3 DIFFERENT PATTERNS OF KEY SOCKETS. 3

Regular "**IONA**" which takes cord through hole in porcelain button.
The "**PURITAN**" socket in which the cord goes through grooves in outer edge of porcelain.
The "**STANDARD**" socket is made with short ribbed shell.

SEND FOR SAMPLES.

IONA MFG. CO., 336 Congress Street, BOSTON, MASS.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

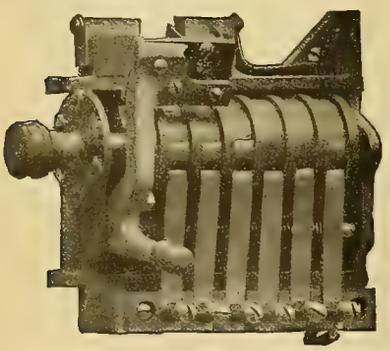
The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

Consolidated Car-Heating Co.,

Chicago, Ill. **ALBANY, N. Y.** Coatecook, P. Q.

COMFORT. **SAFETY.**



Electric Car-Heating.

Regulating Switch Gives

FIVE DIFFERENT INTENSITIES OF HEAT.

In Practical Operation in More Than 25 Leading Cities in U. S. and Canada.

IMPORTANT ANNOUNCEMENT!

We are now prepared to fill orders for the

OLD SUNBEAM INCANDESCENT LAMPS.

SUNBEAM INCANDESCENT LAMP COMPANY,
102 Michigan Avenue, CHICAGO.

Selling Agents: { THE ANSONIA ELECTRIC CO., Corner Randolph St. and Michigan Ave., Chicago.
CHAS. D. SHAIN, 136 Liberty Street, New York.
THE ANSONIA ELECTRIC CO., Ansonia, Conn.

Don't Make a Blunder!

But have your burned-out armature rewound by us with our

Improved Insulation.

Satisfaction guaranteed in all Electrical repairing. Storage batteries recharged and repaired.

Andrews & Haschke,

Gaff Building, 13 and 15 S. Canal St., Chicago.

The Osborne Steam Engineering Co.,

ENGINEERS,

Rooms 714-715, 167 Dearborn St., • Chicago.

Representative work now in course of construction, 2 000 H. P. Heat, Light and Power Plant for the Pabst Heat, Light & Power Co., Milwaukee, Wis.

Those who contemplate the construction of similar plants on improved and economical lines will do well to communicate with us. First, be sure you will get the best, then go ahead.

PURE

SAL-AMMONIAC.

Guaranteed Over 99 Per Cent. Fare.

INNIS & CO.,
161 Kinzie St., Chicago.

MICA

All Sizes and Qualities

For Electrical Purposes.

EUGENE MUNSELL & CO.,
218 Water Street, New York.
W. H. SILLS, 86 Lake Street, CHICAGO, ILL.

Sole Agents for "Micanite."

THE PULLMAN ELECTRIC CO.,

RE-winding
REpairing **ELECTRIC MACHINERY,**

ARMATURES, FIELDS and CONVERTERS.

Motor and Dynamo Inspection and Maintenance.

44 So. Jefferson Street, CHICAGO.

SAL AMMONIAC

(ELECTRIC BRAND)

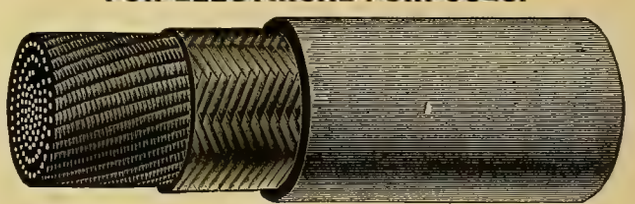
For Electrical Purposes

Guaranteed 98/99% and free of lead and iron. If you want the best quality ask your dealer for this brand. Imported by

A. KLIPSTEIN, 122 Pearl St., New York

Insulated Wire

FOR ELECTRICAL PURPOSES.



Magnet Wire, Office and Annunciator Wire, Lead Covered Cables, Copper Wire, Telegraph Wire.

Send for Catalogue. ADDRESS,

JOHN A. ROEBLING'S SONS CO.,

CHICAGO, 173 Lake St. **SAN FRANCISCO,** 25 and 27 Fremont St. **NEW YORK,** 117 Liberty St. **TRENTON,** N. J.

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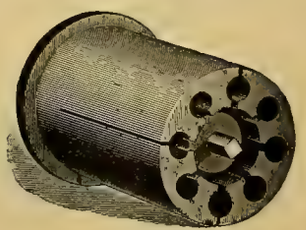

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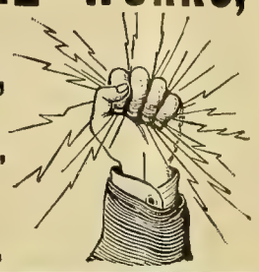

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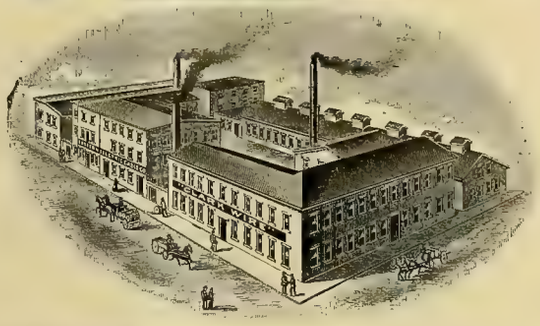

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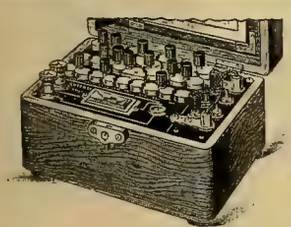

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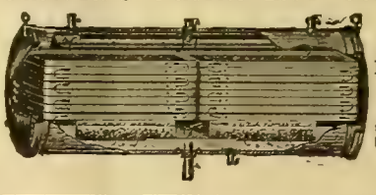

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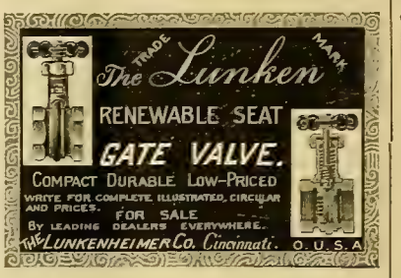

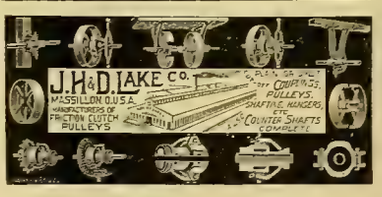

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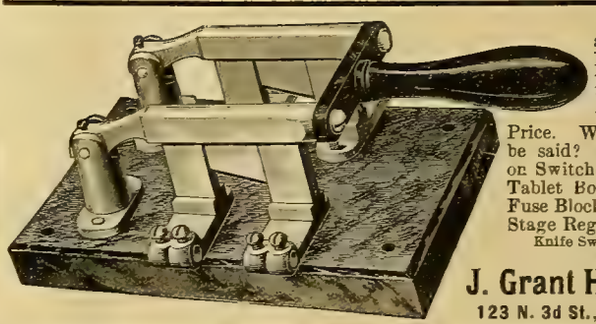

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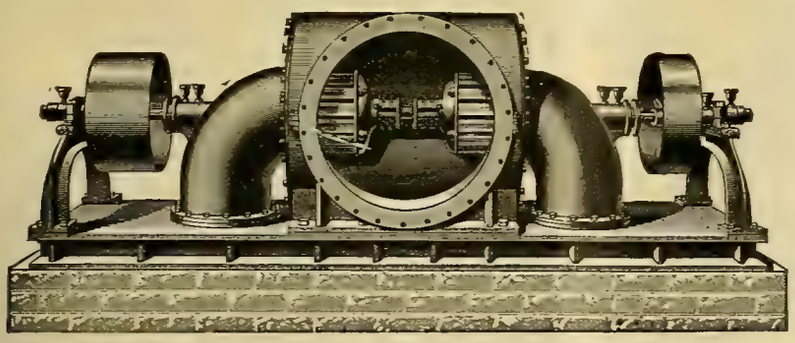

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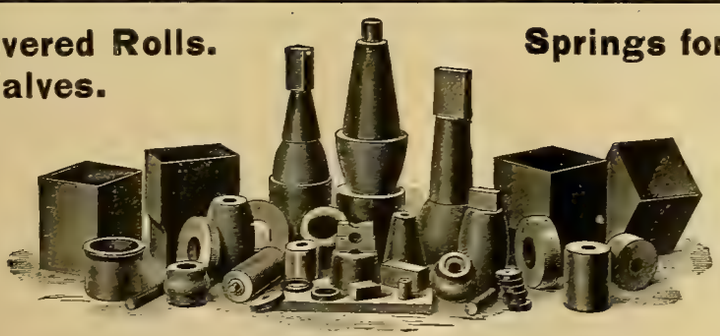

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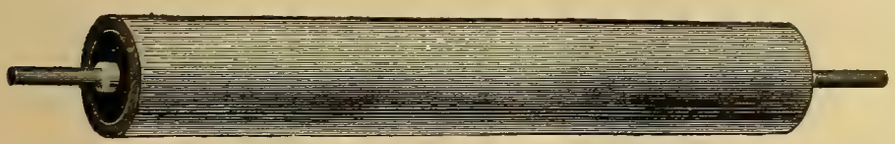

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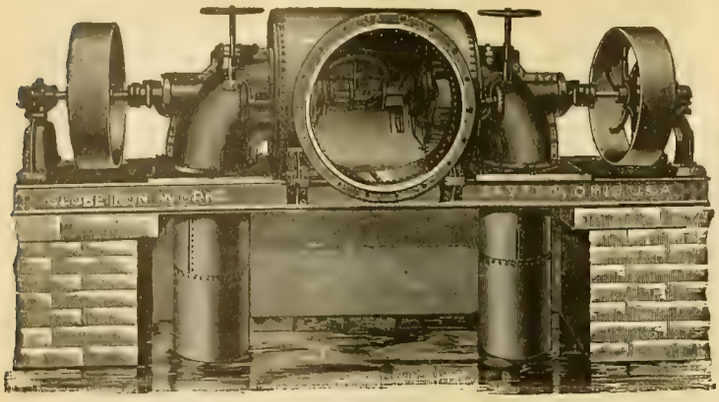

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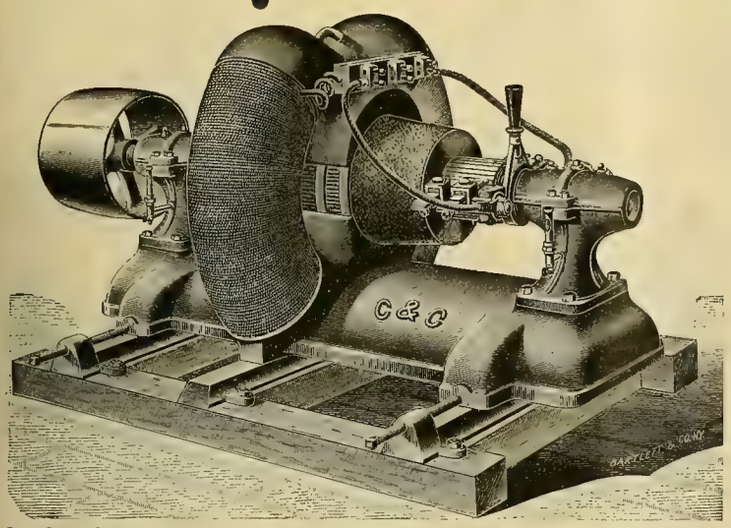

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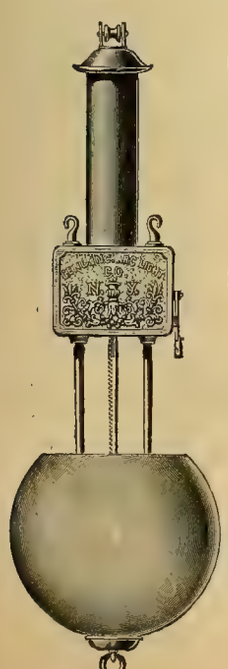

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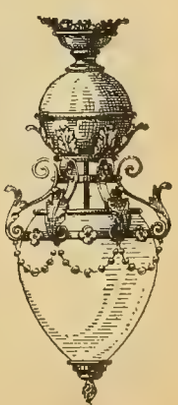

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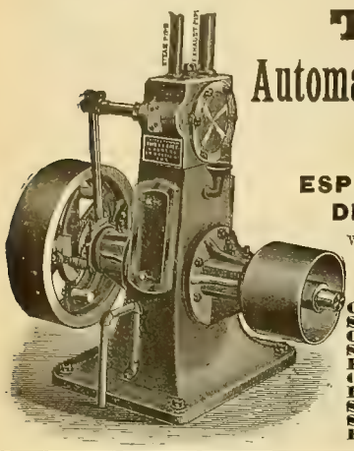

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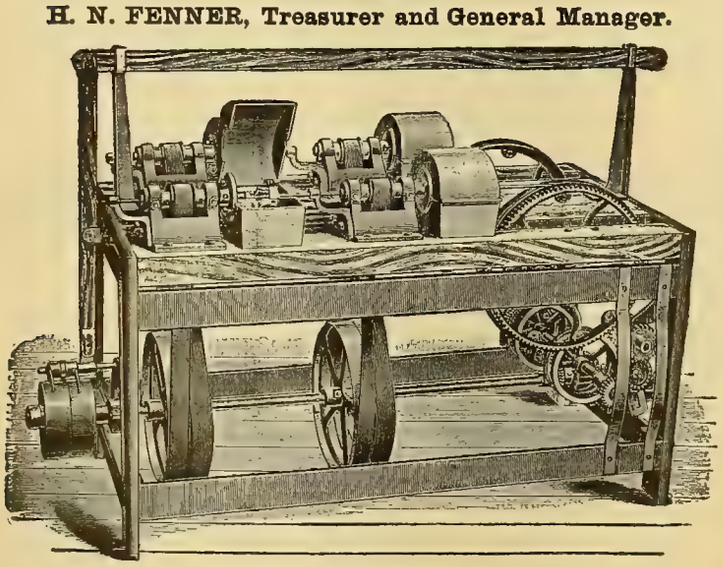

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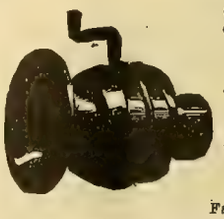

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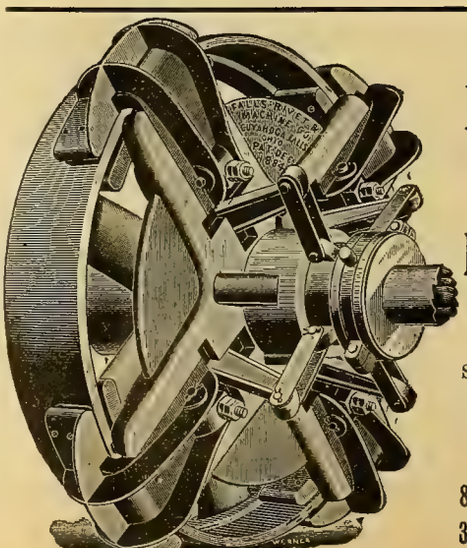

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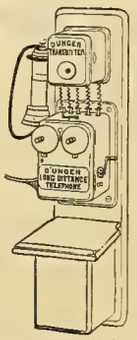

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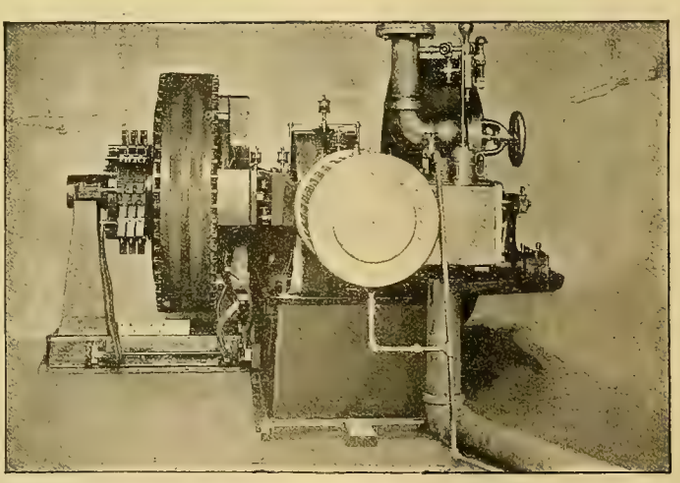

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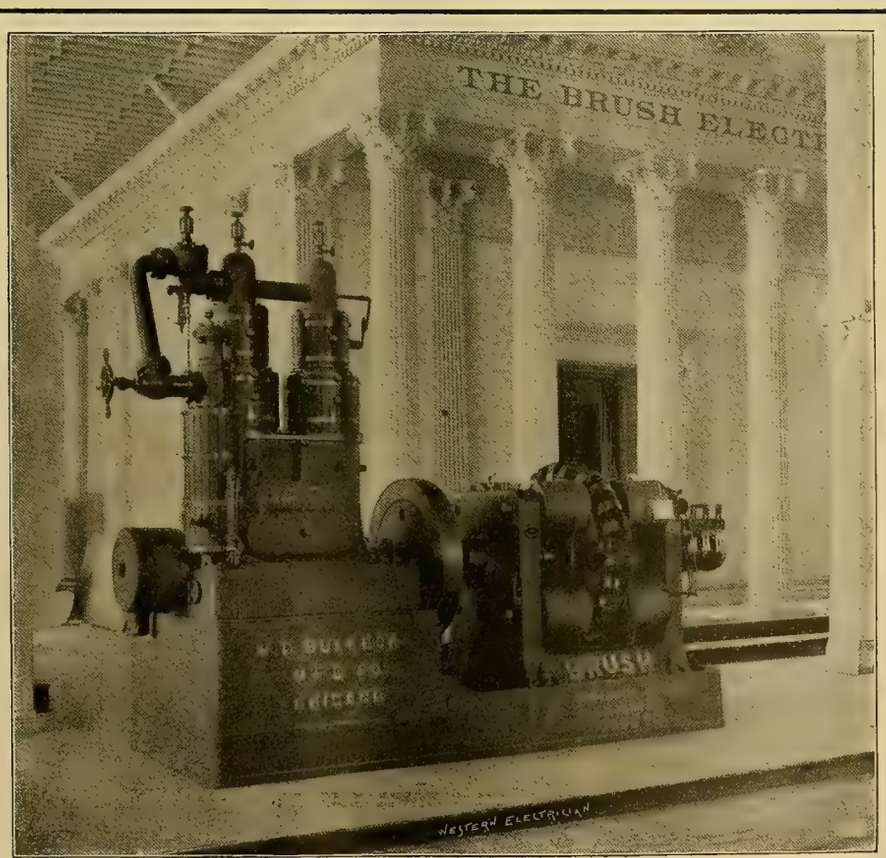

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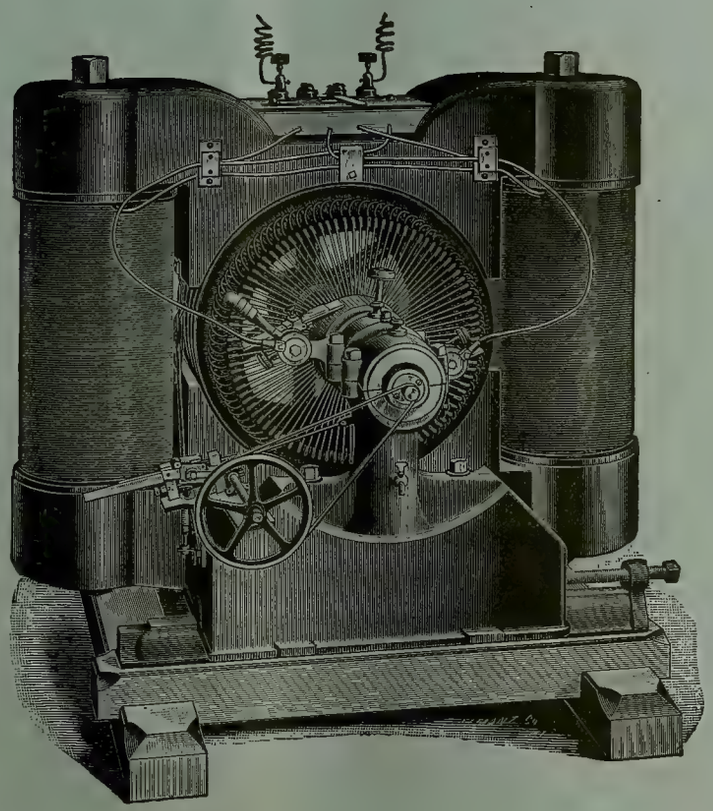

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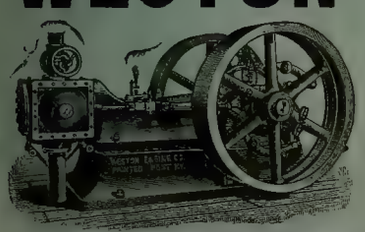

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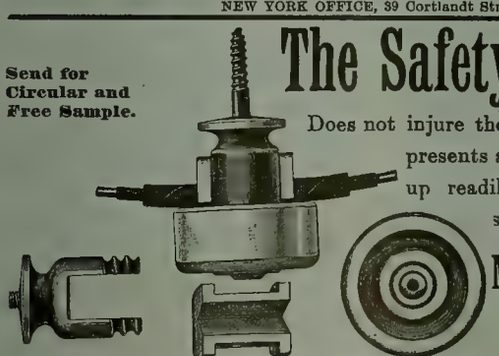

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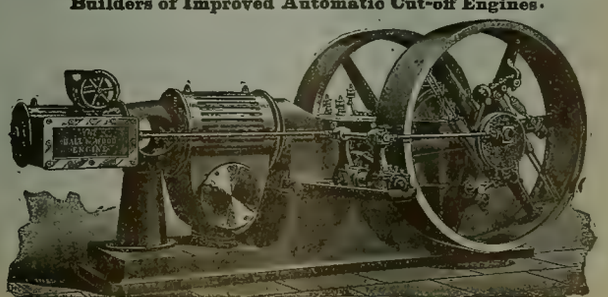

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Accumulators.
Bradbury-Stone Elec. S. Co.
Electric Storage Battery Co.
Pumpelly-Sorley S .B. Co.

Annunciators.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Ostrander &Co., W. R.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Arc Lamps.
Beggs, J. E., Mchy & Sup. Co.
C. & C Electric Co.
Carter & Co.. Geo. G.
Electric Appliance Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co.. The.
Little. F. P. Elec. C. & S. Co.
Rose Elec. Light Supply Co.
Siemens & Halske Electric Co.
StandardElectric Co.
Taylor, Dee & Mack.
Washington Electric Co
Westinghouse El. & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Central Electric Co.
Electric Appliance Co.

Armature Winders.
Andrews & Haschke.
Pullman Electric Co.

Batteries and Jars.
Bradbury-Stone Elec. S. Co.
Bunnell & Co , J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Law Battery Co.
Leclanche Battery Co., The.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Miamisburg Electric Co.
Newton Rubber Co.
Pumpelley-Sorley S. B. Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.
White, S. S. Dental Mfg. Co.

Bells.
Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S.
Metropolitan Electric Co.
Ostrander & Co.. W. R.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Belting.
Shultz Belting Co.

Boilers.
Babcock & Wilcox Co., The.
Ball Engine Co.
Freeman & Sons Mfg. Co.
Link Belt Machinery Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Braiding Machinery.
New England Butt Co.

Brass Goods.
Lunkenheimer Co., The.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Cables(See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Carter & Co.,' Geo. G.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Spruance, D. C.
Taylor, Dee & Mack.
Western Electric Co.

Carbons, Points & Plates.
Central Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co
Western Electric Co.

Car-Heaters, Electric.
Consolidated Car-Heating Co.
Taylor, Dee & Mack.

Clutches, Friction.
Falls Rivet & Machine Co.
Lake, J. H. & D. Co.
Link Belt Machinery Co.

Contractors and Electric Light Plants.
Allen-Hussey Co.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C. & C. Electric Co.
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Complete Elec. Const. Co.
Comstock, Louis K.
Fort Wayne Electric Co.
General Electric Co.
Little, F. P. Elec. C. & S. Co.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Royal Electric Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
Stone. O. M.
United Elec Improvement Co
Waddell-Entz Company.
Westinghouse Elec & Mfg. Co.
Western Electric Co.

Construction and Repairs.
Adams, W. L. & Co.
Allen-Hussey Co.
Andrews & Haschke.
C. & C. Electric Co.
Capitol Model & Mach. Wks.
Comstock, Louis K.
General Electric Co.
Little, F. P. Elec. C. & S. Co.
Osburn, Harry G.
Pullman Electric Co.
Sioux City E. S. Co.
Stone, O. M.
Western Electric Co.

Copper.
Law Battery Co.
Miamisburg Electric Co.

Copper Wires.
Adams. W. L. & Co.
American Electrical Works.
Bernard Co., The E. G.
Bishop Gutta Percha Co.
Bunnell & Co , J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Spruance, D. C.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Cross-Arms, Pins and Brackets.
Adams. W. L. & Co.
Anderson, Albert & J. M.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Taylor, Dee & Mack.

Cut-Outs and Switches.
Adams, W. L. & Co.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Electric Selector & Signal Co.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Iona Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
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Sioux City E. S. Co.
Taylor, Dee & Mack.
Washington Electric Co.
Western Elec. Supply Co.

Desk Lights.
McLeod. Ward & Co.

Dynamos.
Brush Electric Co.
C. & C. Electric Co.
Fort Wayne Electric Co.
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Royal Electric Co.
Siemens & Halske Electric Co.
Standard Electric Co.
United Elec Improvement Co
Waddell-Entz Company.
Western Electric Co.
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Siemens & Halske Electric Co.
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Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
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Comstock, Louis K.
Merrill, Frederick L.
Monrath, Gustave
Osborne Steam Eng. Co.
Osburn, Harry G.
Stone. O. M.

Electrical Instruments.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Iona Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Queen & Company, Incorp.
Taylor, Dee & Mack.
Van Nuis, C. S.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

Electrical Specialties.
Andrews & Haschke.
Capitol Model & Mach. Wks.
Electric Appliance Co.
Holtzer-Cabot Electric Co.
Iona Mfg. Co.
McLeod, Ward & Co.
Washington Electric Co.

Electroliers, etc.
Baggot, E.
Edwards, W. S. Mfg. Co.

Elevators, Electric.
Morse, Williams & Co.

Engines, Steam.
Ball & Wood Co., The.
Ball Engine Co.
Case, J. T. Engine Co.
Freeman Sons Mfg. Co.
Weston Engine Co.

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Central Electric Co.
Electric Appliance Co.
Stanley Electric Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

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Western Electric Co.

Fuse Wire.
Electric Appliance Co.
Independent Electric Co.

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Holtzer-Cabot Electric Co.

Gears.
Grant, Geo. B.

General Elec. Supplies.
Adams, W. L. & Co.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Central Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
Law Battery Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Queen & Co., Incorp.
Sioux City Elec. Supply Co.
Taylor, Dee & Mack.
Washington Electric Co.
Western Elec. Supply Co.

Globes and Electrical Glassware.
Baggot, E.

Graphite Specialties.
Dixon Crucible Co., Jos.

Hard Rubber Goods.
Butler Hard Rubber Co.
Mica Insulator Co.
Newton Rubber Co.

Inc. Lamp Repairing
New York Electric Co.

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Adams, W. L. & Co.
Anderson, Albert & J. M.
Andrews & Haschke.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Mica Insulator Co.
Moore, Alfred F.
Munsell & Co.. Eugene.
McLeod, Ward & Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.
Vulcanized Fibre Co.
Washington Electric Co.
Western Elec. Supply Co.

Insulated Wires and Cables—Magnet Wire.
Adams, W. L. & Co.
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
McLeod Ward & Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Son's Co., J. A.
Spruance, D. C.
Taylor, Dee & Mack.
Waddell-Entz Company.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent.
Am. Electric Mfg. Co.
Beacon Vacuum Pump & Electrical Co.
Bernstein Electric Co.
Buckeye Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
New York and Ohio Co.
New York Electric Co.
Taylor, Dee & Mack.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.

Magnet Wire.
(See Insulated Wires.)

Mica.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Brush Electric Co.
C. & C. Electric Co.
General Electric Co
Gregory, Chas. E. Co.
Royal Electric Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Waddell-Entz Company.
Westinghouse El. & Mfg. Co.

Paints.
Standard Paint Co.

Patents.
Rosenbaum, Wm. A.
Stocking, E. B.

Phosphor Bronze.
Phosphor Bronze Sm.Co.,Ltd.

Platinum.
Baker & Co.

Porcelain.
Empire China Works.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electric Appliance Co
Metropolitan Electric Co.

Rheostats.
General Electric Co.
Washington Electric Co.

Sal Ammoniac.
Innis & Co.
Klipstein, A.
Law Battery Co.

Second-Hand Electrical Machinery.
Beggs, J. E. Mach. & Sup.Co.
Gregory, Chas. E. Co.
Rose Elec. Lt. Supply Co.

Silk Braid.
Boston Braid Mfg. Co.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co. Incorp.
Whitney Elec. Instrument Co.

Steam Heating.
Webster & Co., Warren.

Steam Pumps.
Worthington, Henry R.

Storage Batteries.
Bradbury-Stone Elec. S. Co.
Electric Storage Battery Co.
Pumpelly-Sorley S. B. Co.

Stoves, Electric.
Consolidated Car-HeatingCo.

Street Cars.
Brill, J. G. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.

Telegraph Apparatus.
Central Electric Co.
Electric Appliance Co.
Electric Selector & Signal Co.
Greely & Co., The E. S
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

Telephones,
D'Unger Elec. Tel. Mfg. Co.
Manhattan Elec. Sup. Co.
Western Electric Co.
Western Tel. Const. Co.

Transformers.
Royal Electric Co.
Stanley Electric Mfg. Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Tools.
Lunkenheimer Co., The.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Stilwell & Bierce Mfg. Co.

Universities.
Armour Institute.
Correspondence School of Technology.
Institute of Technology.

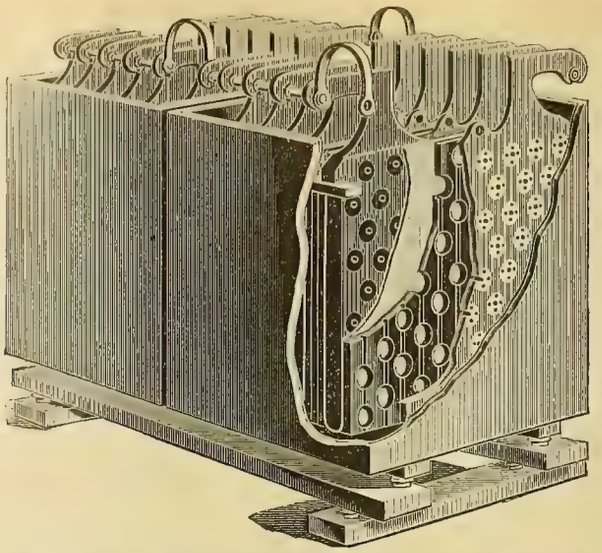
Valves.
Lunkenheimer Co., The.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.

Wire, Bare.
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co
National India Rubber Co
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons' Co., J. A.
Spruance, D. C.
Taylor, Dee & Mack.



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Chicago, Ill. ALBANY, N. Y. Coatecook, P. Q.

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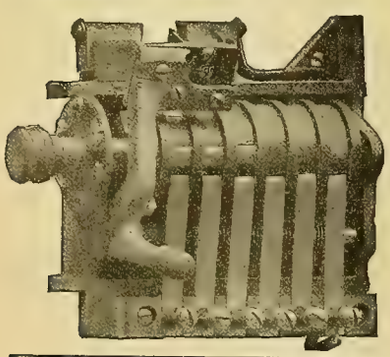

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1894. FEBRUARY. 1894.

SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.
				1 (32)	2 (33)	3 (34)
4 (35)	5 (36)	6 (37)	7 (38)	8 (39)	9 (40)	10 (41)
11 (42)	12 (43)	13 (44)	14 (45)	15 (46)	16 (47)	17 (48)
18 (49)	19 (50)	20 (51)	21 (52)	22 (53)	23 (54)	24 (55)
25 (56)	26 (57)	27 (58)	28 (59)			

MOON'S PHASES. NEW MOON. 5th FIRST QR. 13th FULL MOON. 19th LAST QR. 27th

JANUARY

SU	M	TU	W	TH	F	SA
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

FEBRUARY

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

MARCH

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

APRIL

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

MAY

SU	M	TU	W	TH	F	SA
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JUNE

SU	M	TU	W	TH	F	SA
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

COMBINATION CALENDAR TABLET
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JULY

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
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30	31					

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"Did the defendant in good faith act upon the complainants' limitation of the life of their patent, and was it so induced to act by the conduct of the complainants, and is it now in such relation to the complainants as estops them from denying that their conduct induced the defendant to make its investments and act as it has set forth in its motion now under consideration?

"The circumstances under which the defendant began its enterprise of manufacturing Electric Incandescent Lamps: The different stages in the progress of its development, and the reasons inducing it to increase its capital are fully set forth in its motion and as hereinbefore recited.

"Without deciding how far others not similarly situated had the right to rely upon such conduct on the part of the complainants or without passing upon the question, of how far the public generally acquired rights under the complainants' proceedings in the patent office by which they limited the life of their patent, it is sufficient to find under this motion, that the defendant by reason of the circumstances particularly set forth in its motion did rely upon the complainants' conduct, and had a right to be, and was in fact influenced thereby.

"If I am in error as to this conclusion no great harm can result to the complainants, and their right to contest as to other infringers not able to show such meritorious claims to estoppel, as this defendant has established can be asserted without prejudice from this decision."

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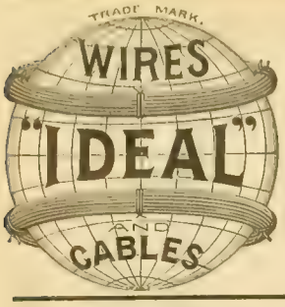

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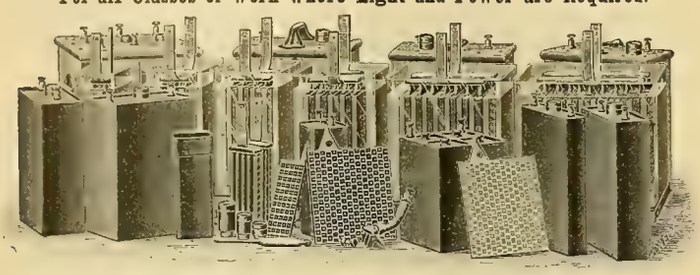

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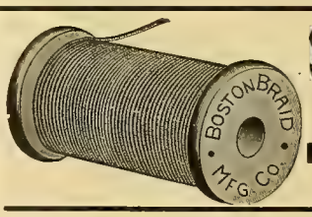

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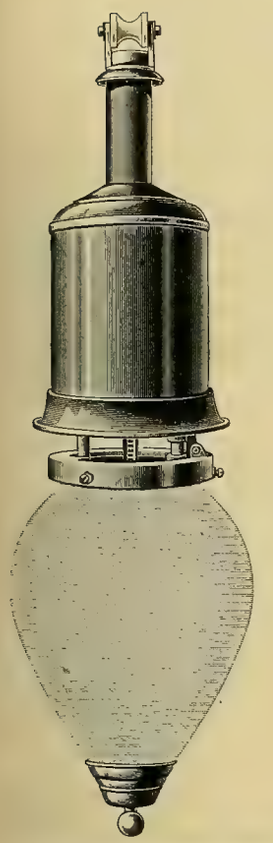

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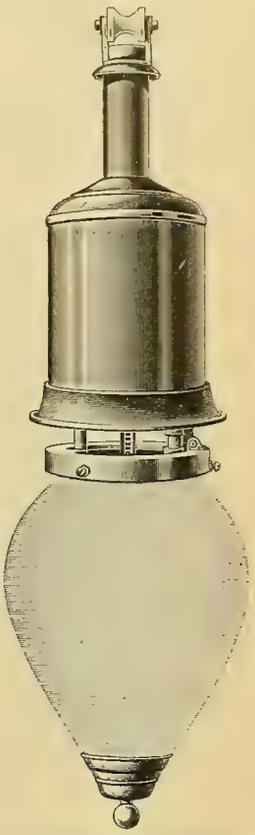

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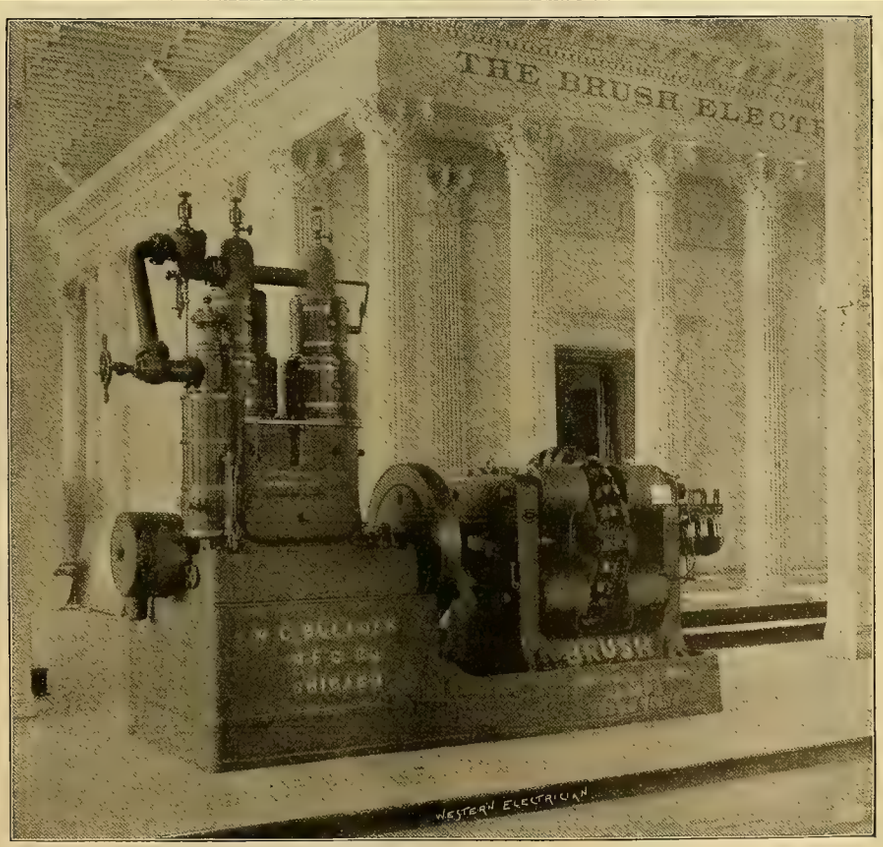

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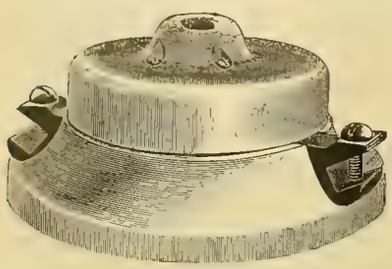

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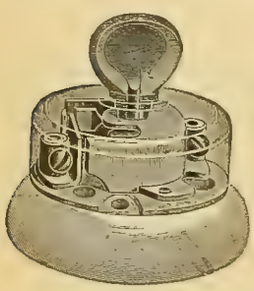

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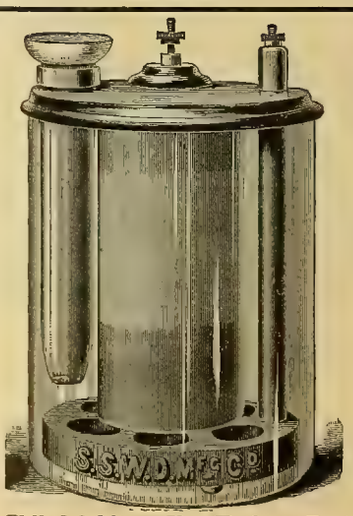

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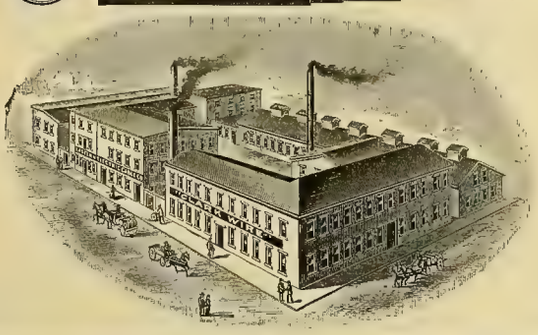

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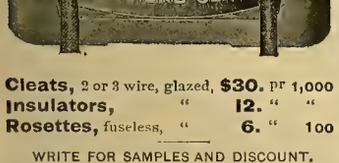

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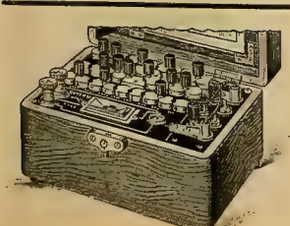

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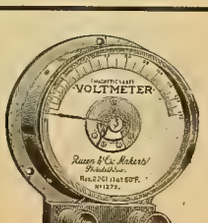

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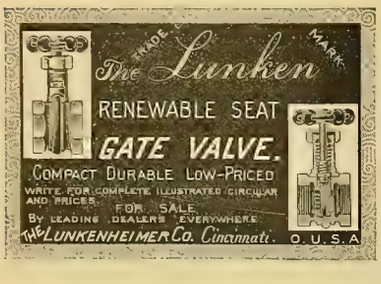

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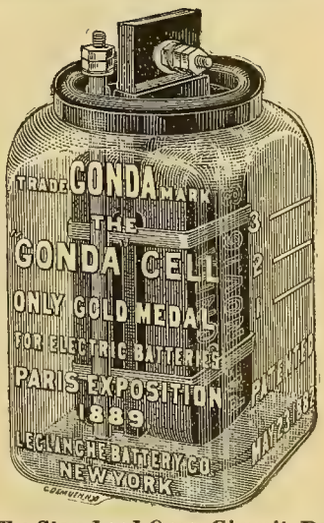

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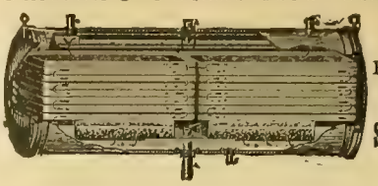

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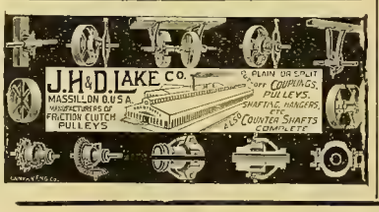

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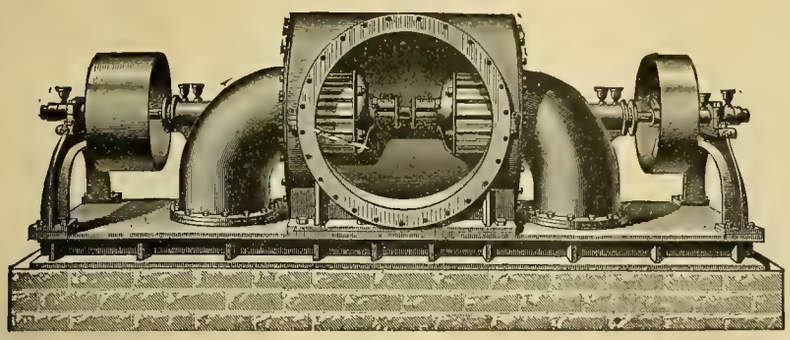

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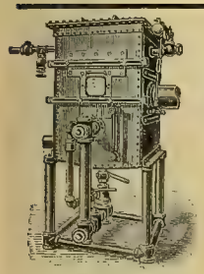

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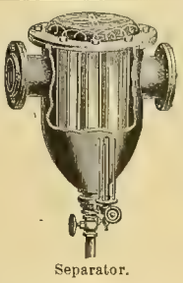

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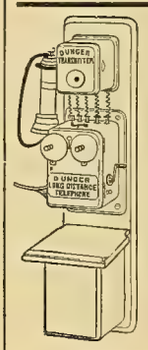

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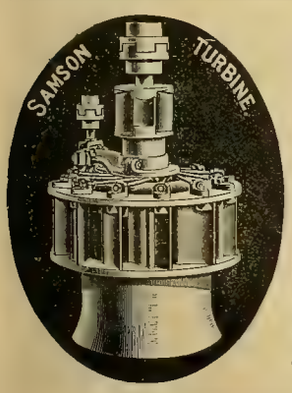

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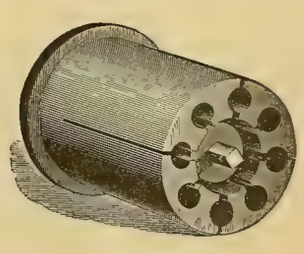

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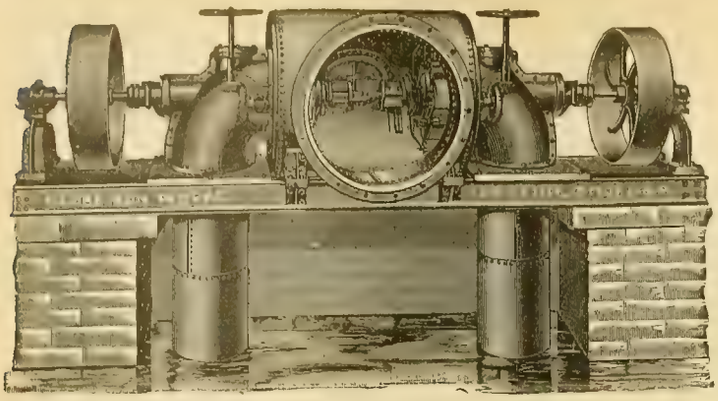

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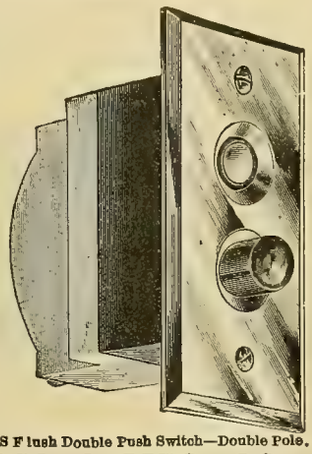

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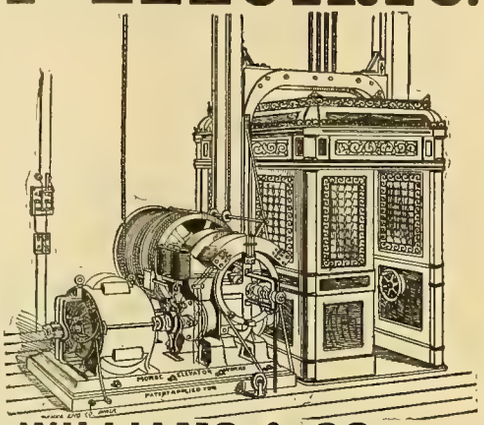

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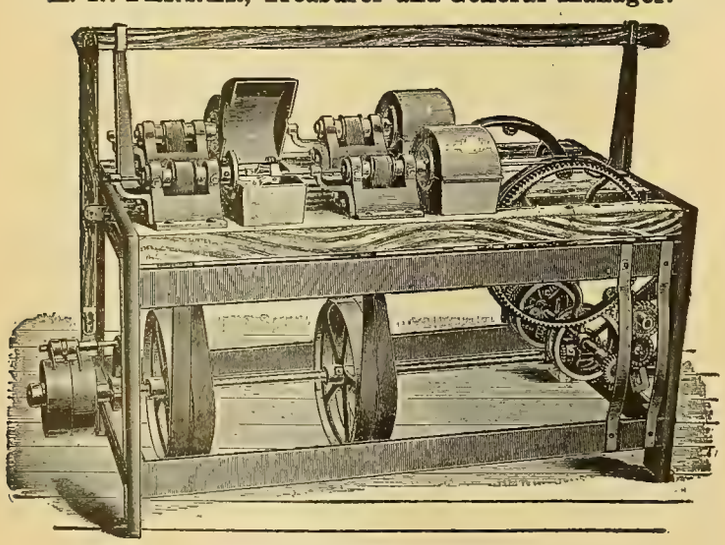

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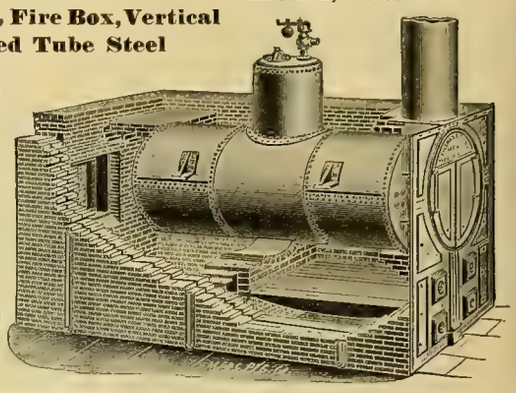

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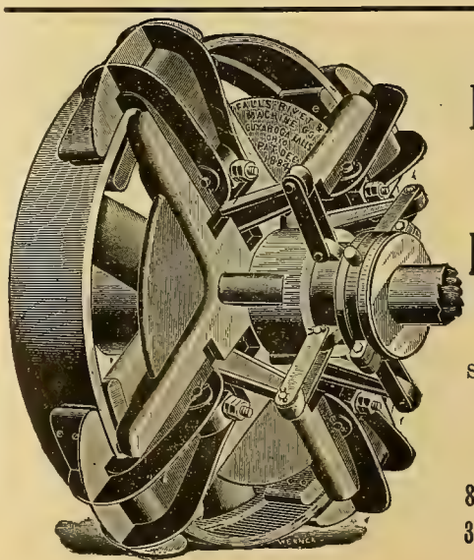

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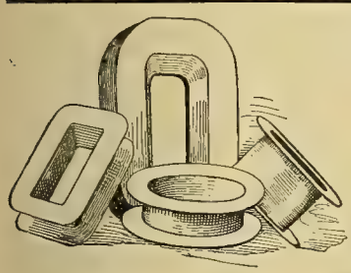

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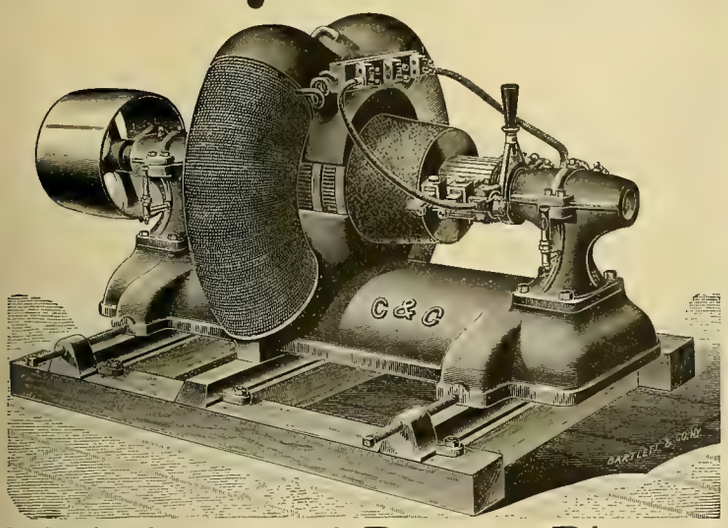

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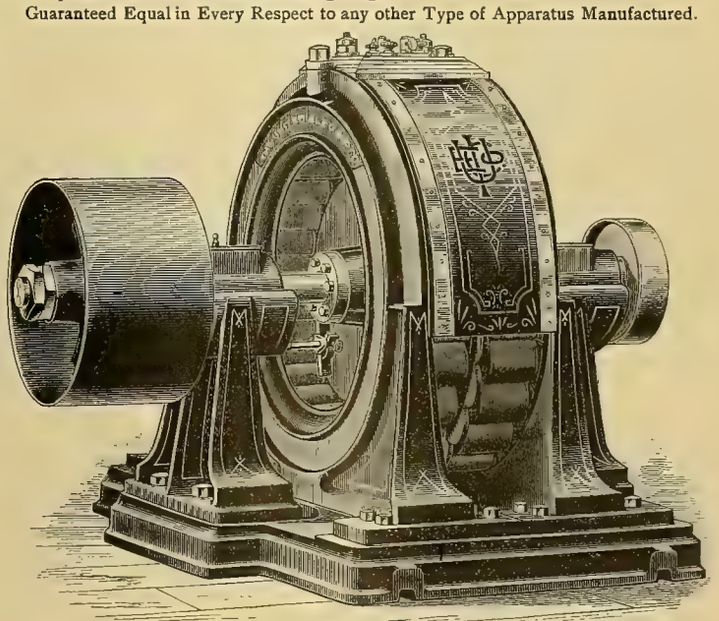

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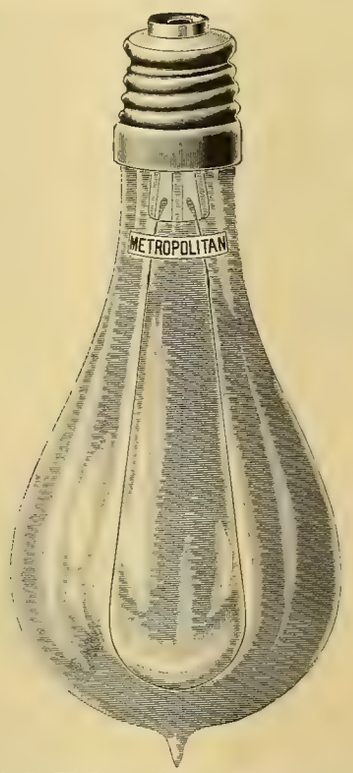

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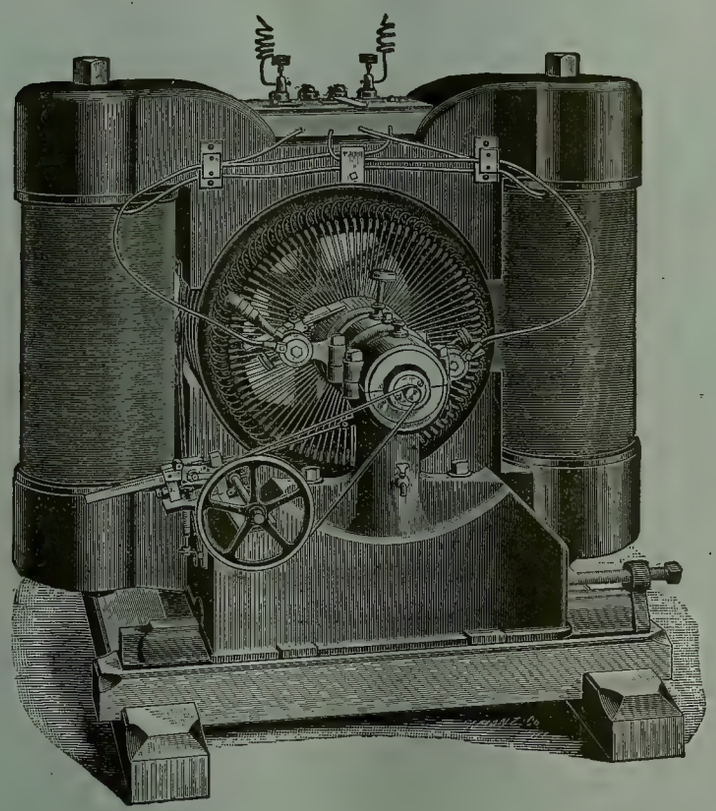

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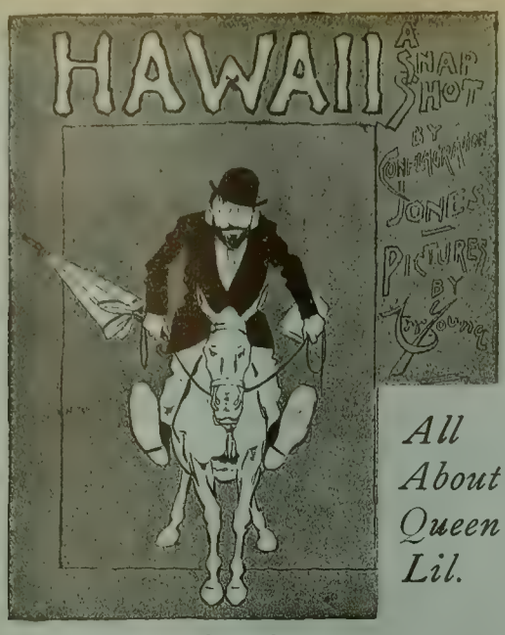

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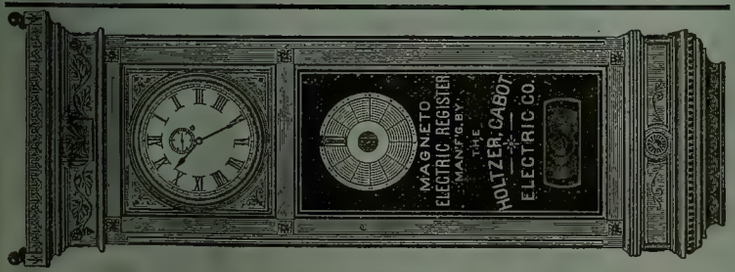

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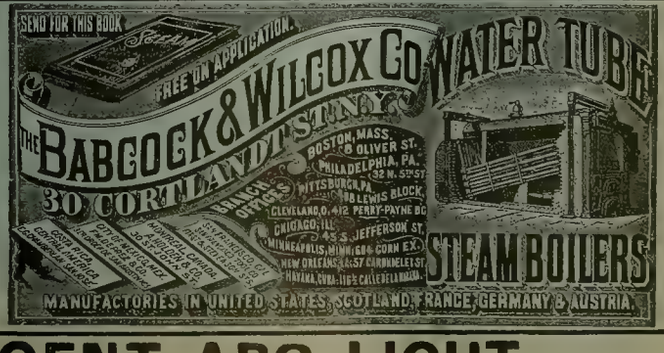

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Siemens & Halske Electric Co..... —
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Accumulators.
Bradbury-Stone Elec. S. Co.
Electric Storage Battery Co.
Pumpelly-Sorley S .B. Co.

Annunciators.
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Electric Appliance Co,
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Taylor, Dee & Mack.
Western Elec. Supply Co.

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C. & C Electric Co.
Carter & Co., Geo. G.
Electric Appliance Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rose Elec. Light Supply Co.
Royal Arc Electric Co.
Siemens & Halske Electric Co.
Standard Electric Co.
Taylor, Dee & Mack.
Washington Electric Co
Westinghouse El. & Mfg. Co.
Western Electric Co.

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Central Electric Co.
Electric Appliance Co.

Armature Winders.
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Bradbury-Stone Elec. S. Co.
Bunnell & Co , J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliancc Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Law Battery Co.
Leclanche Battery Co., The.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Miamisburg Electric Co.
Newton Rubber Co.
Pumpelley-Sorley S. B. Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.
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Electric Appliance Co.
Greely & Co., The E. S.
Metropolitan Electric Co.
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Shultz Belting Co.

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Ball Engine Co,
Freeman & Sons Mfg. Co.
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Electrician Publishing Co.

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New England Butt Co.

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Lunkenheimer Co., The.

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Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Washington Electric Co.
Western Electric Co.
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Cables (See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar.**
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Bishop Gutta Percha Co.
Carter & Co.. Geo. G.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Spruance, D. C.
Taylor, Dee & Mack.
Western Electric Co.

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Central Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co
Western Electric Co.

Car-Heaters, Electric.
Consolidated Car-Heating Co.
Taylor, Dee & Mack.

Clutches, Friction.
Falls Rivet & Machine Co.
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Link Belt Machinery Co.

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Amstutz, N. S.
Andrews & Haschke.
C. & C. Electric Co.
Capitol Model & Mach. Wks
Comstock, Louis K.
General Electric Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co
Mather Electric Co.
Osburn, Harry G.
Pullman Electric Co.
Sioux City E. S. Co.
Stone, O. M.
Western Electric Co.

Contractors and Electric Light Plants.
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C. & C. Electric Co.
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Colburn Electric Mfg. Co.
Complete Elec. Const. Co.
Comstock, Louis K.
Fort Wayne Electric Co.
General Electric Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Royal Electric Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
Stone. O. M.
United Elec Improvement Co
Waddell-Entz Company.
Westinghouse Elec & Mfg. Co.
Western Electric Co.

Copper.
Law Battery Co.
Miamisburg Electric Co.

Copper Wires.
Adams, W. L. & Co.
American Electrical Works.
Bernard Co., The E. G.
Bishop Gutta Percha Co.
Bunnell & Co , J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Spruance, D. C.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

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Adams. W. L. & Co.
Anderson, Albert & J. M.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Taylor, Dee & Mack.

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Adams, W. L. & Co.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Electric Selector & Signal Co.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Iona Mfg. Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
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Taylor, Dee & Mack.
Washington Electric Co.
Western Elec. Supply Co.

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McLeod, Ward & Co.

Dynamos.
Brush Electric Co.
C. & C. Electric Co.
Colburn Electric Mfg Co.
Fort Wayne Electric Co.
General Electric Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co,
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Royal Electric Co.
Siemens & Halske Electric Co.
Standard Electric Co.
United Elec Improvement Co
Waddell-Entz Company.
Western Electric Co.
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Brush Electric Co
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Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
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Merrill, Frederick L.
Monrath, Gustave
Osborne Steam Eng. Co.
Osburn, Harry G.
Stone. O. M.

Electrical Instruments.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Iona Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Queen & Company, Incorp.
Taylor, Dee & Mack.
Van Nuis, C. S.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

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Andrews & Haschke.
Capitol Model & Mach. Wks.
Electric Appliance Co.
Holtzer-Cabot Electric Co.
Iona Mfg. Co.
McLeod, Ward & Co.
Washington Electric Co.

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Edwards, W. S. Mfg. Co.

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Colburn Electric Mfg. Co.

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Morse, Williams & Co.

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Ball & Wood Co., The.
Ball Engine Co.
Case, J. T. Engine Co.
Freeman Sons Mfg. Co.
Weston Engine Co.

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Central Electric Co.
Electric Appliance Co.
Stanley Electric Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

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Western Electric Co.

Fuse Wire.
Electric Appliance Co.
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Gas Lighting, Electric.
Holtzer-Cabot Electric Co.

Gears.
Grant, Geo. B.

General Elec. Supplies.
Adams, W. L. & Co.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Central Electric Co.
Colburn Electric Mfg. Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
La Roche Electric Wks.
Law Battery Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Queen & Co., Incorp.
Sioux City Elec. Supply Co.
Taylor, Dee & Mack.
Washington Electric Co.
Western Elec. Supply Co.

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Baggot, E.

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Butler Hard Rubber Co.
Mica Insulator Co.
Newton Rubber Co.

Inc. Lamp Repairing
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Adams, W. L. & Co.
Anderson, Albert & J. M.
Andrews & Haschke.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Mica Insulator Co.
Moore, Alfred F.
Munsell & Co., Eugene.
McLeod, Ward & Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.
Vulcanized Fibre Co.
Washington Electric Co.
Western Elec. Supply Co.

Insulated Wires and Cables—Magnet Wire.
Adams, W. L. & Co.
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co..J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
McLeod Ward & Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Son's Co., J. A.
Spruance, D. C.
Taylor, Dee & Mack.
Waddell-Entz Company.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent.
Am. Electric Mfg. Co.
Beacon Vacuum Pump & Electrical Co.
Bernstein Electric Co.
Buckeye Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Mather Electric Co.
Metropolitan Electric Co.
New York and Ohio Co.
New York Electric Co.
Royal Arc Electric Co.
Taylor, Dee & Mack,

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.

Magnet Wire.
(See Insulated Wires.)

Mica
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Brush Electric Co.
C. & C. Electric Co.
Colburn Electric Mfg. Co.
General Electric Co
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
Royal Electric Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Waddell-Entz Company.
Westinghouse El. & Mfg. Co.

Paints.
Standard Paint Co.

Patents.
Stocking, E. B.

Phosphor Bronze.
Phosphor Bronze Sm.Co.,Ltd.

Platinum.
Baker & Co.

Porcelain.
Empire China Works.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electric Appliance Co
Metropolitan Electric Co

Rheostats.
General Electric Co.
Washington Electric Co.

Sal Ammoniac.
Innis & Co.
Klipstein, A.
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Gregory, Chas. E. Co.
Rose Elec. Lt. Supply Co.

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Boston Braid Mfg. Co.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Western Electric Co.

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Queen & Co. Incorp.
Whitney Elec. Instrument Co

Steam Heating.
Webster & Co., Warren.

Steam Pumps.
Worthington, Henry R.

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Bradbury-Stone Elec. S. Co.
Electric Storage Battery Co.
Pumpelly-Sorley S. B. Co.

Stoves, Electric.
Consolidated Car-Heating Co.

Street Cars.
Brill, J. G. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.

Telegraph Apparatus.
Central Electric Co.
Electric Appliance Co.
Electric Selector & Signal Co.
Greely & Co., The E. S
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

Telephones,
D'Unger Elec. Tel. Mfg. Co.
Manhattan Elec. Sup. Co.
Western Electric Co.
Western Tel. Const. Co.

Transformers.
Royal Electric Co.
Stanley Electric Mfg. Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Tools.
Lunkenheimer Co., The.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Stilwell & Bierce Mfg. Co.

Universities.
Armour Institute.
Correspondence School of Technology.
Institute of Technology.

Valves.
Lunkenheimer Co., The.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.

Wire, Bare.
Anderson, Albert & J. M.
Bishop Gutta Percha Co,
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co
National India Rubber Co
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons' Co., J. A.
Spruance, D. C.
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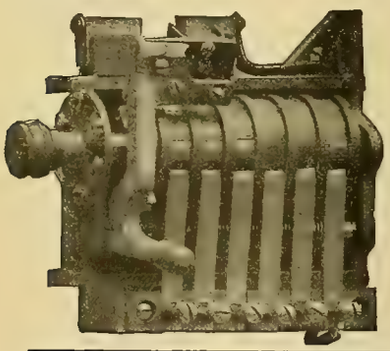

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SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.
				1 (32)	2 (33)	3 (34)
4 (35)	5 (36)	6 (37)	7 (38)	8 (39)	9 (40)	10 (41)
11 (42)	12 (43)	13 (44)	14 (45)	15 (46)	16 (47)	17 (48)
18 (49)	19 (50)	20 (51)	21 (52)	22 (53)	23 (54)	24 (55)
25 (56)	26 (57)	27 (58)	28 (59)			

JANUARY

SU	M	TU	W	TH	F	SA
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

FEBRUARY

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

MARCH

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

APRIL

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

MAY

SU	M	TU	W	TH	F	SA
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JUNE

SU	M	TU	W	TH	F	SA
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

COMBINATION CALENDAR TABLET
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JULY

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

AUGUST

SU	M	TU	W	TH	F	SA
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

SEPTEMBER

SU	M	TU	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

OCTOBER

SU	M	TU	W	TH	F	SA
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

NOVEMBER

SU	M	TU	W	TH	F	SA
			1	2	3	
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

DECEMBER

SU	M	TU	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

MOON'S PHASES.	NEW MOON.	FIRST QR.	FULL MOON.	LAST QR.
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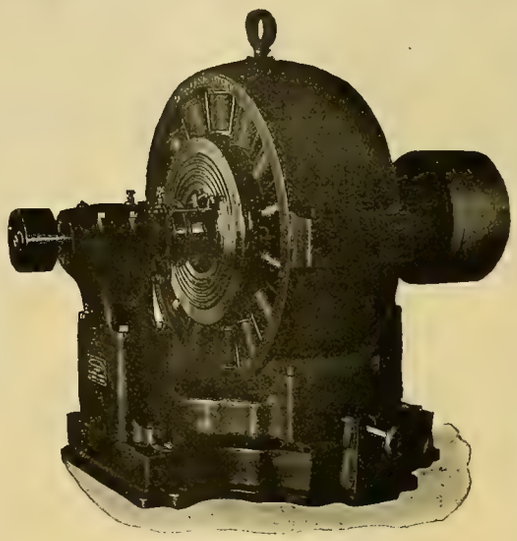

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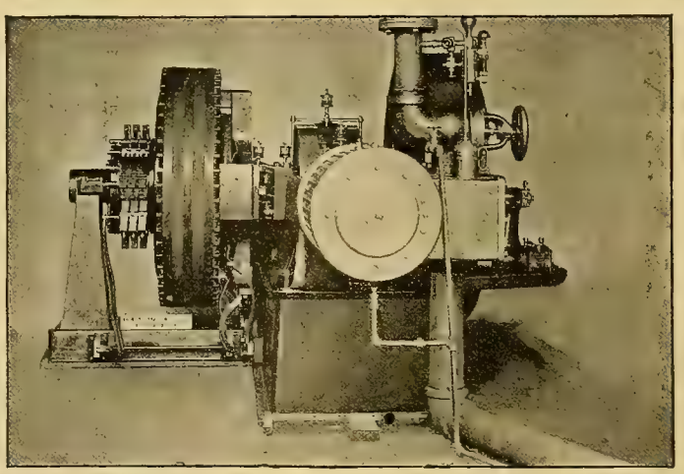

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THE MATHER ELECTRIC COMPANY has discontinued its General Selling Office, at Boston, and will hereafter transact all business directly from its main office at MANCHESTER, CONN., to which place all communications should be addressed to receive immediate attention.

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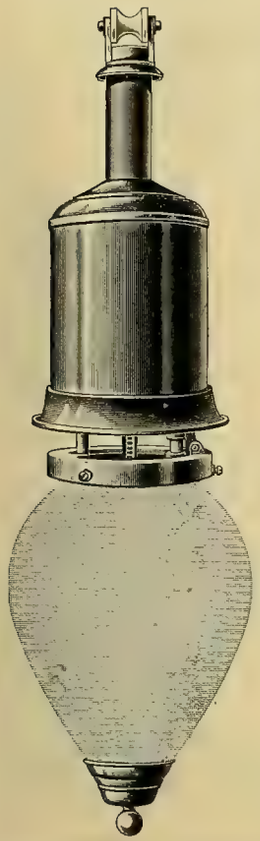

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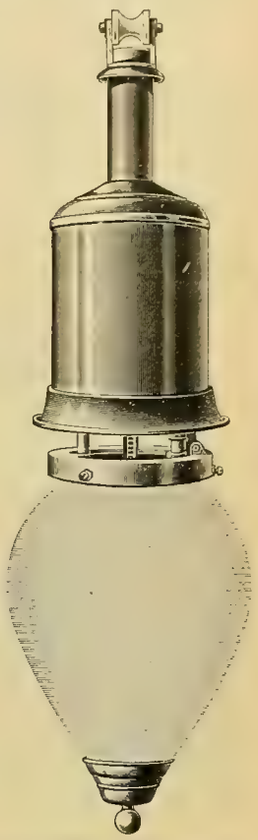

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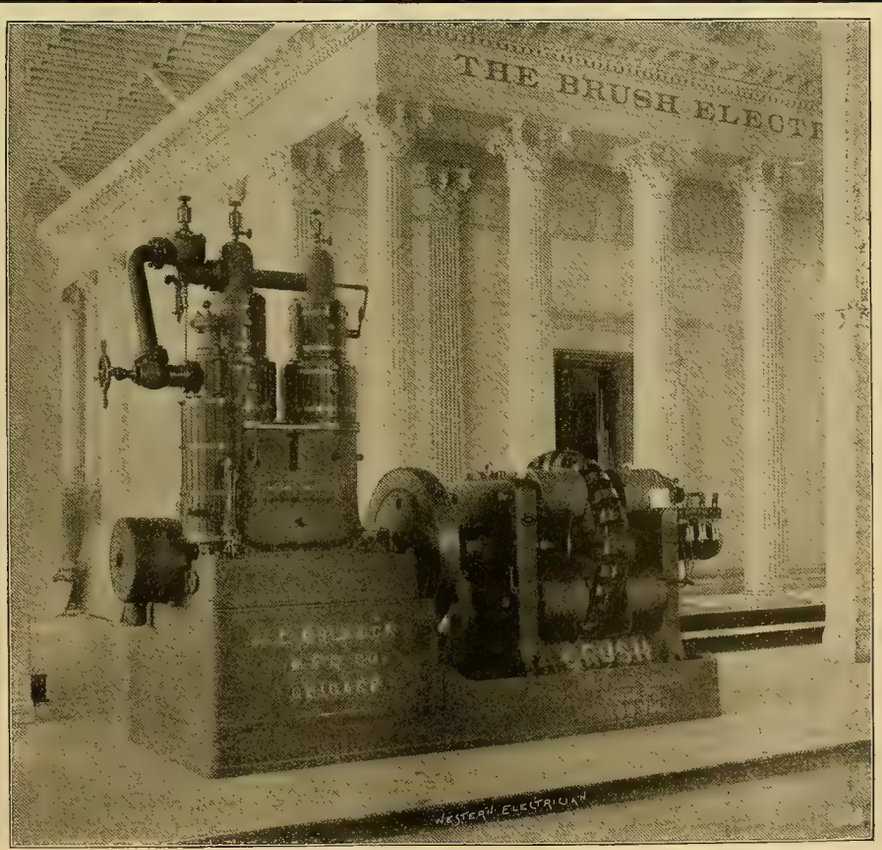

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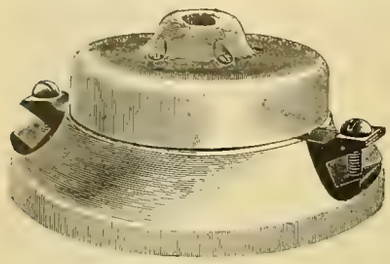

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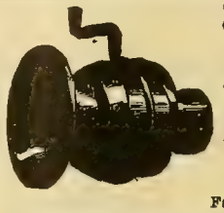

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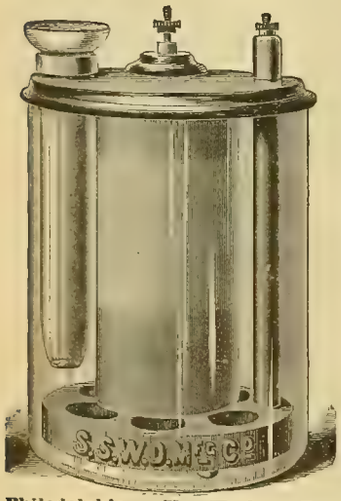

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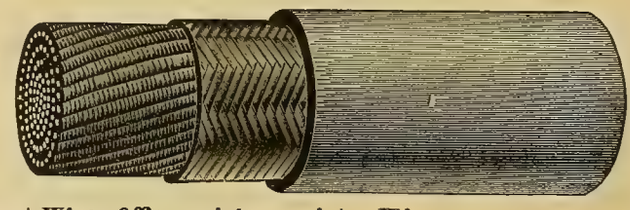

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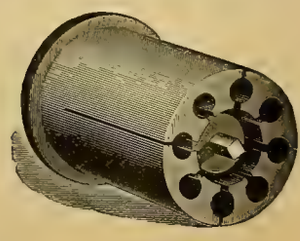

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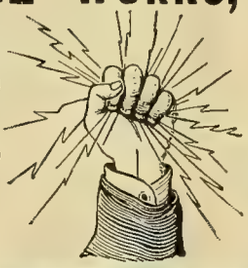

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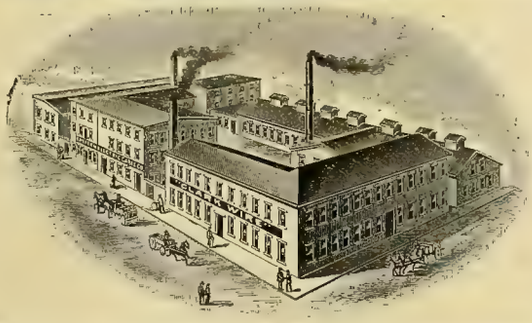

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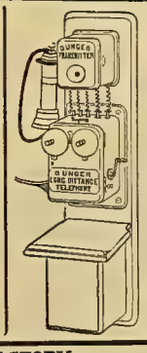

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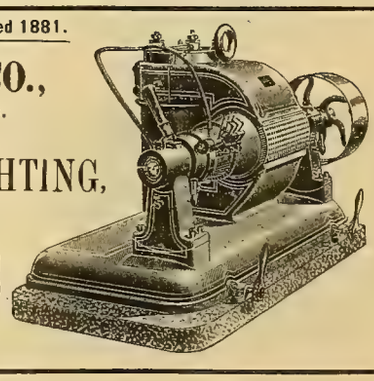

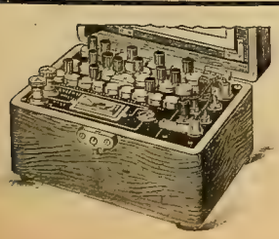

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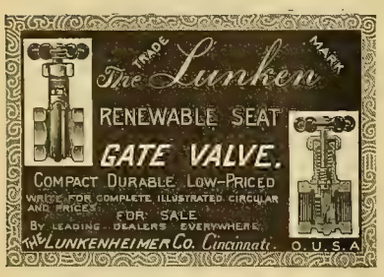

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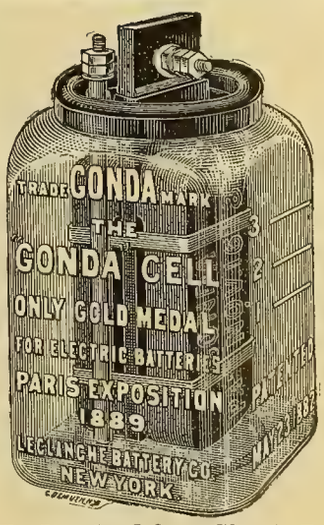

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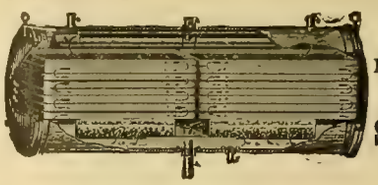

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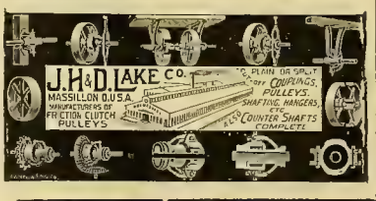

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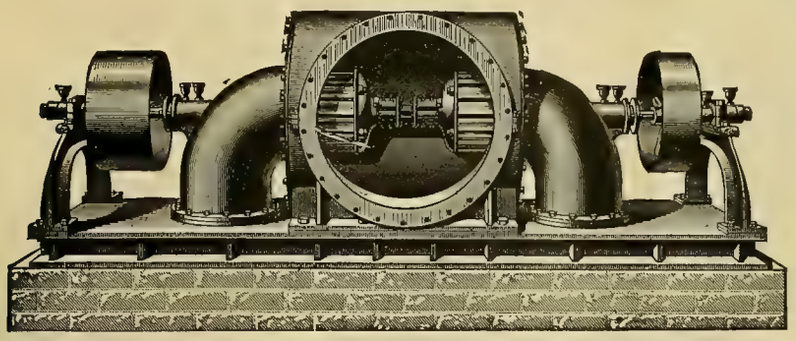

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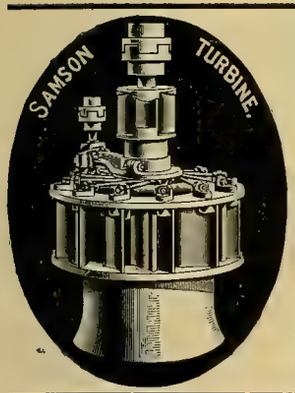

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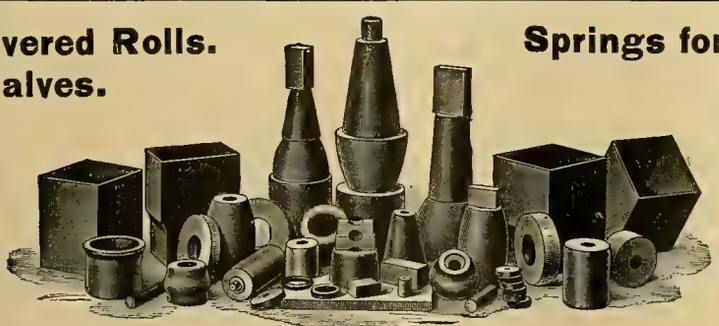

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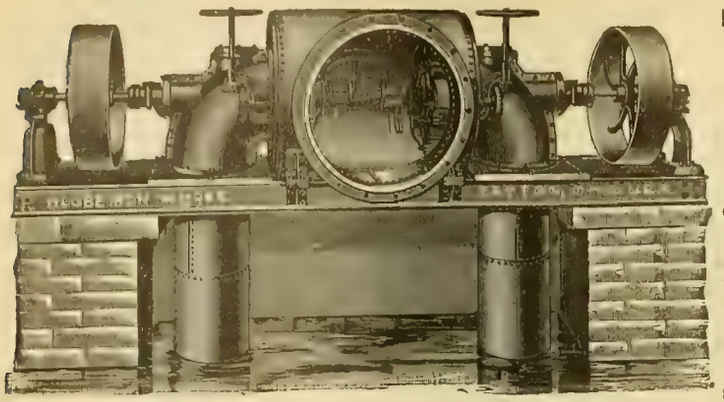

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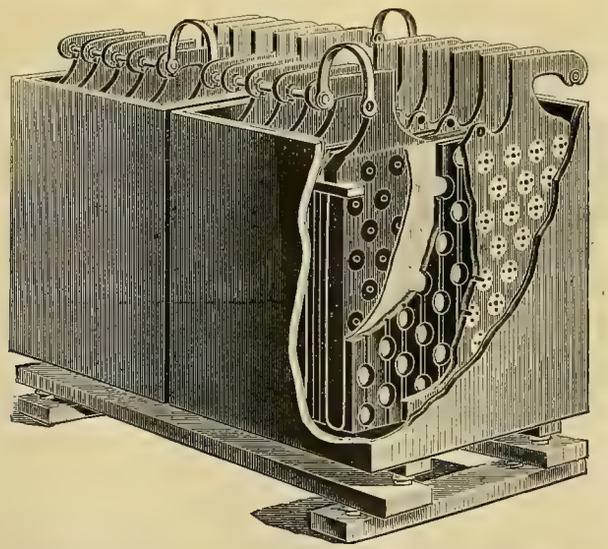

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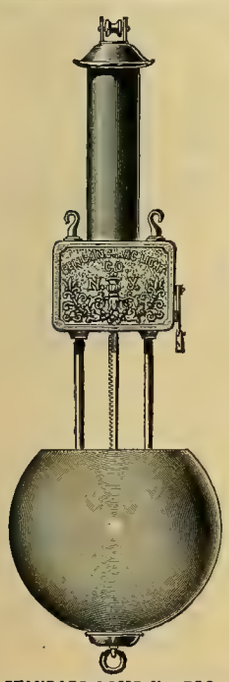

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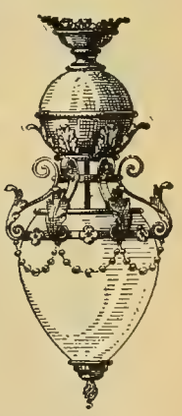

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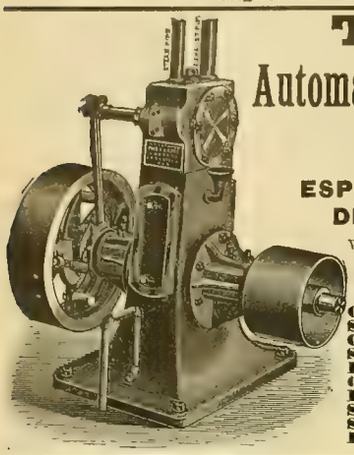

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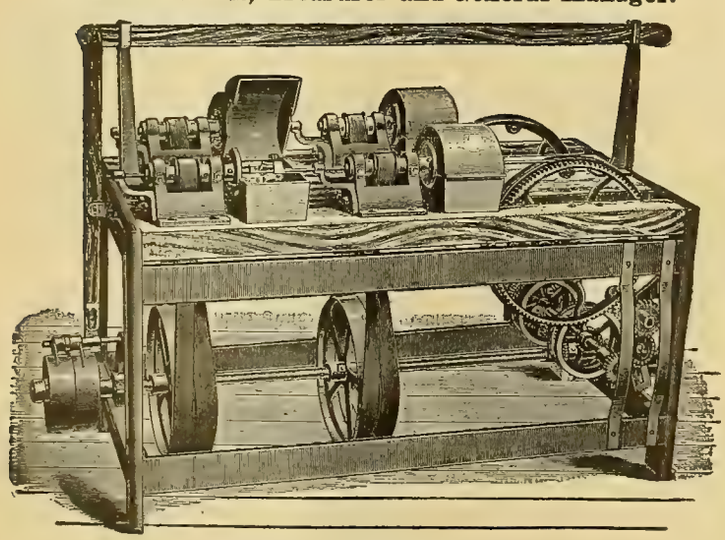

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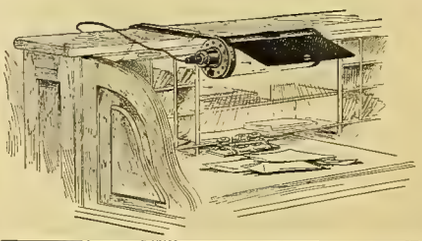

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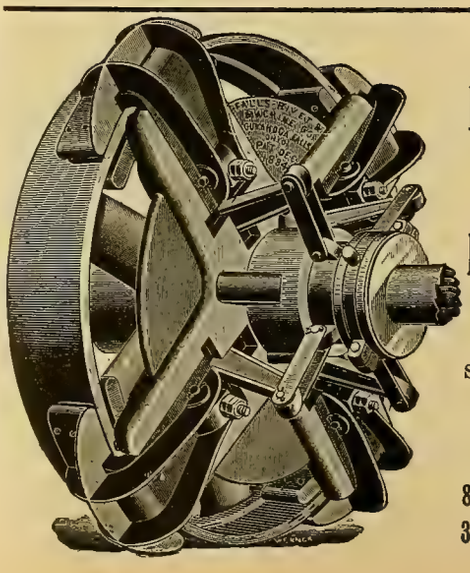

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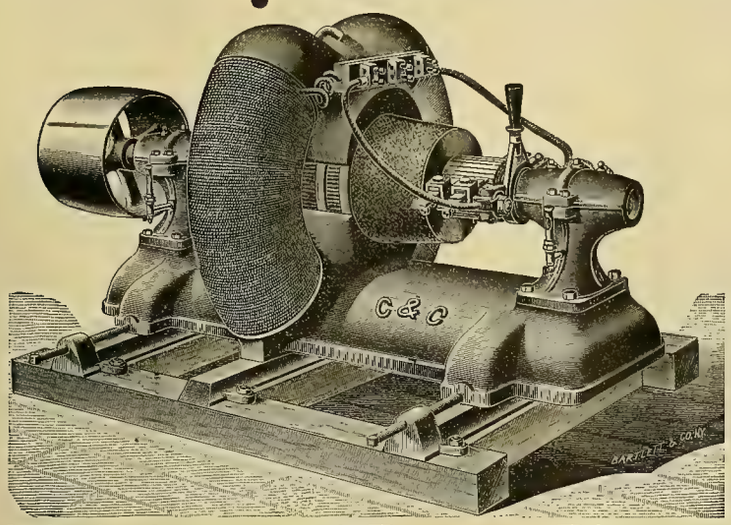

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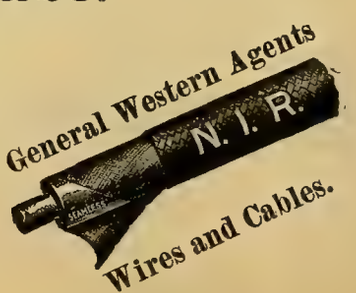

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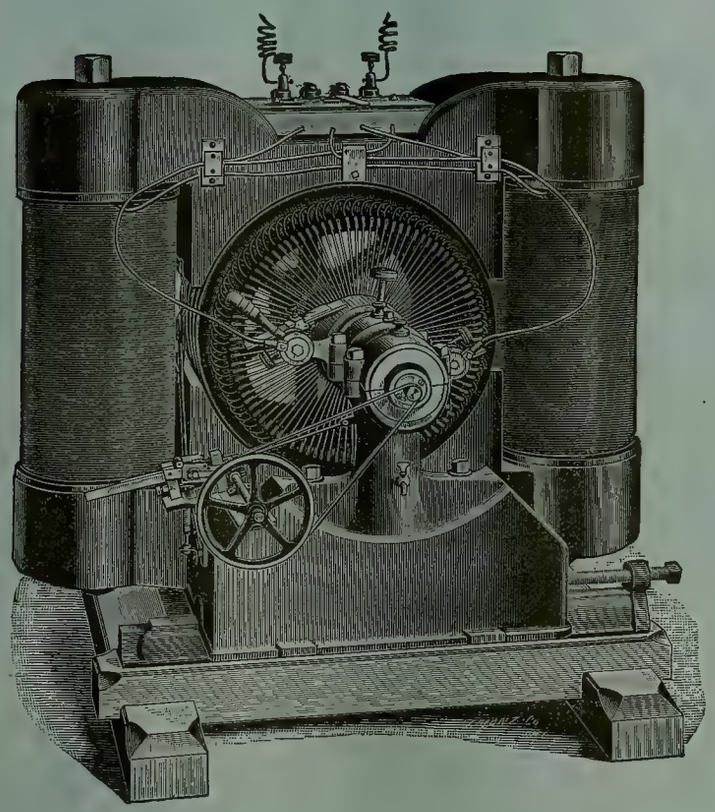

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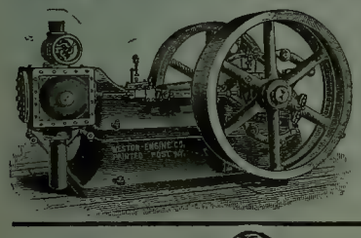

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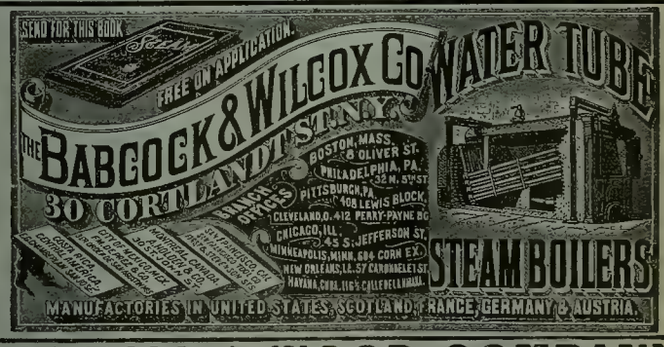

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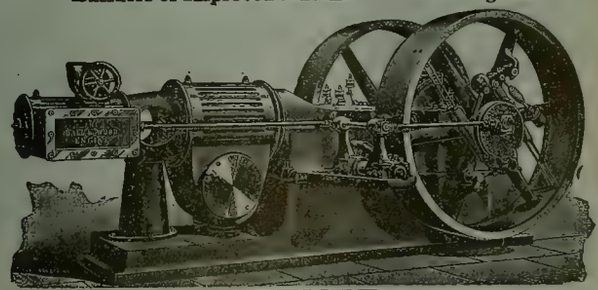

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Western Elec. Supply Co.
White, S. S. Dental Mfg. Co.

Bells.
Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Taylor, Dee & Mack.
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Shultz Belting Co.

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Babcock & Wilcox Co., The.
Ball Engine Co.
Freeman & Sons Mfg. Co.
Link Belt Machinery Co.
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Electrician Publishing Co.

Braiding Machinery.
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Lunkenheimer Co., The.

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New York Ins. Wire Co.
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Law Battery Co.
Leclanche Battery Co.
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Consolidated Car-Heating Co.
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Falls Rivet & Machine Co.
Lake, J. H. & D. Co.
Link Belt Machinery Co.

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Allen-Hussey Co.
Amstutz, N. S.
Andrews & Haschke.
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Comstock, Louis K.
General Electric Co.
La Roche Electric Wks.
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Colburn Electric Mfg. Co.
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General Electric Co.
La Roche Electric Wks.
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Mather Electric Co.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Stone. O. M.
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Law Battery Co.
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Iona Mfg. Co.
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Anderson, Albert & J. M.
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C. & C. Electric Co.
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Iona Mfg. Co.
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McMillan, Hugh.
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Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
La Roche Electric Wks.
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Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
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McMillan, Hugh.
Queen & Co., Incorp.
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Carter & Co., Geo. G.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Holtzer-Cabot Electric Co.
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Johns Mfg. Co., H. W.
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Manhattan Elec. Sup. Co.
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Munsell & Co., Eugene.
McLeod, Ward & Co.
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Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
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Vulcanized Fibre Co.
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Bishop Gutta Percha Co.
Bunnell & Co.. J. H.
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Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
McLeod Ward & Co.
McMillan. Hugh.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
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Okonite Co., The.
Phillips Insulated Wire Co.
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Greely & Co., The E. S
Metropolitan Electric Co.
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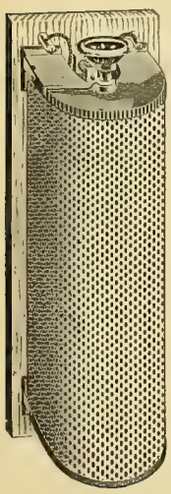

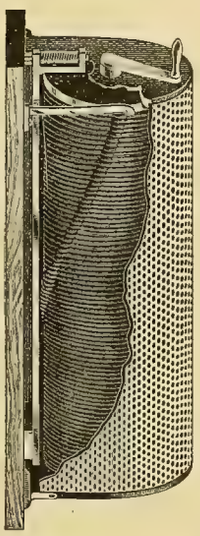

Contact made on wires direct instead of on segment face.

Changes from light to dark and vice versa, made perfectly even and gradual.

Finest scenic effects produced without difficulty.

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Just at present, but is likely to be found again soon, so if you want anything,

NOW IS THE TIME TO BUY!

Ask for quotations on

Railway Generators, Motors, Station Appliances, Line Supplies, Rail Bonds, Etc.

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Stationary Motors, (Constant Potential).

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BARREL LOTS 32½ CENTS.

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QUALITY UNEXCELLED.

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Metal-Sheathed Bushings,

Made especially to conform to the requirements of the Underwriters' Regulations.

We take pleasure in presenting to the Trade an *armored bushing* made to comply with Underwriters' Requirements.

It is thoroughly "*water-proof,*" "*non-combustible*" and has superior insulating qualities: The Armor gives strength and durability, which neither Glass, Porcelain nor Vulcanized Rubber possess.

It has a small external diameter, and requires a much smaller hole than Glass, Porcelain or Hard Rubber. The large head prevents breaking or splitting and the smooth brass armor makes the bushing easily driven into position.

PRICE LIST PER 100 PIECES.

LENGTH OVER ALL IN INCHES.	1½	2½	3	4	6	8	10	12	14	16	18
5/16-inch inside diam., 1/2-inch outside diam.,	$2 70	$2 90	$3 00	$3 20	$5 30	$6 05	$6 90	$7 70	$8 65	$9 25	
3/8 " " " 5/8 " " "	2 80	3 00	3 10	3 25	5 65	6 55	7 50	8 50	9 25	10 15	
1/2 " " " 3/4 " " "			4 05	4 50	6 35	7 40	8 50	9 60	10 70	11 80	
5/8 " " " 13/16 " " "			4 10	4 55	6 65	7 75	9 00	10 20	11 40	12 70	$13 75
3/4 " " " 1 " " "				6 35	8 00	9 75	11 00	12 50	14 00	15 55	17 10
1 " " " 1 1/4 " " "				7 60	9 50	11 50	13 40	15 25	16 95	18 85	20 75
1 1/4 " " " " " "					12 25	14 80	17 40	20 00	22 60	25 20	27 80

Any length made to order at proportionate prices.

Underwriters' Requirements.

RULE 18. CONDUCTORS:—Amend Section (*b*) to read as follows:—

***b*. Must be protected when passing through FLOORS; or through walls, partitions, timbers, etc., in places liable to be exposed to dampness, by water-proof, non-combustible, insulating tubes, such as glass or porcelain.**

Must be protected when passing through walls, partitions, timbers, etc., in places not liable to be exposed to dampness by *approved insulating bushings* specially made for the purpose.

RULE 18. CONDUCTORS:—

Section *b*. Second paragraph. Except for FLOORS, *and* for places liable to be exposed to dampness, Glass, Porcelain, *metal-sheathed Interior Conduit,* and Vulca Tube, when made especially for bushings, will be *approved. The two last named will not be approved if cut from the usual lengths of tube made for conduit work, nor when made without a head or flange on one end.*

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SPECIAL AGENTS: Gate City Electric Co., KANSAS CITY.
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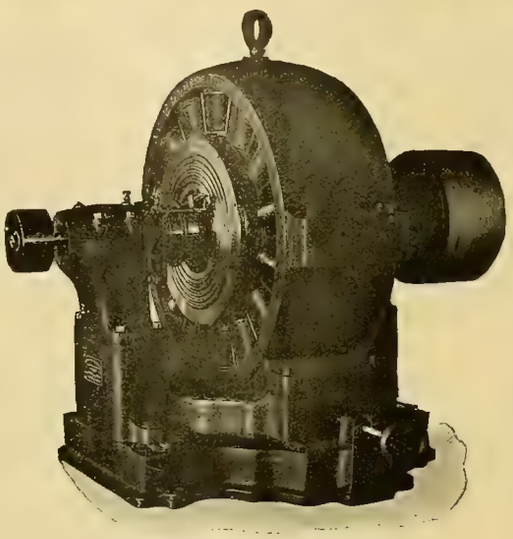
Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

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If you are contemplating the purchase of Alternating Apparatus, get

TWO-PHASE GENERATORS

which will cost no more than single phase. You can then operate lights as economically and as satisfactorily as from single phase generators, and in addition use

ALTERNATING CURRENT MOTORS,

which we are now building in 1, 2, 3, 5, 7, 10 and 15 Horse Power sizes. Our standard

TRANSFORMERS

For lighting purposes are carried in stock, and orders can be filled promptly.

The most economical and easiest handled transformer on the market. Special transformers for any desired voltage. Special transformers for arc lighting.

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Selling Agents for the Helios Arc Lamps in New England and New York State.

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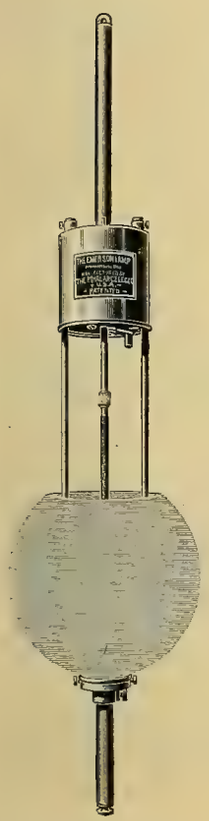
"THE NEW INCANDESCENT ARC LIGHT."

PERFECT DISTRIBUTION OF LIGHT.

FOR ALL CIRCUITS.

COST OF TRIMMING REDUCED TO A MINIMUM.

APPURTENANCES CAN BE ATTACHED TO ANY MAKE OF ARC LAMP.



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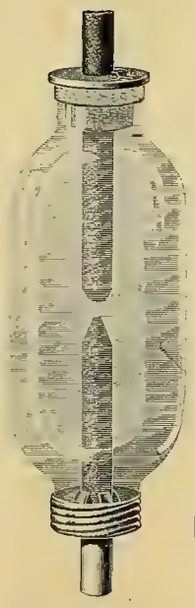

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Pres.,
Hartford Elec. Lt. Co.

Life of one pair of $\frac{7}{16}$ inch carbons over 100 hours.

This system has been introduced in the City of Hartford, Conn. by the Connecticut Royal Arc Co., and has been in continuous operation on street and commercial circuits for the past five months. Merchants in the City of Hartford employing Arc Lights by adopting this appurtenance have been able to save 33⅓ per cent. from established rates made by the Hartford Board of Fire Underwriters.

The commercial advantages enjoyed when this equipment is adopted are many: Cleanliness, removal of anxiety in regard to fire and the necessity for trimming the lamp reduced to twelve times per year, where average lamp hours are employed.

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Direct Current Arc Lighting!

THE LOWEST PRICES!
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THE GENERATOR is of the same excellence of electrical design and mechanical construction as all of our standard apparatus. It produces CONSTANT CONTINUOUS CURRENT, is *Absolutely Automatic in Regulation*, without extra devices, and is the MOST EFFICIENT GENERATOR ever offered. The ARMATURE COILS are MACHINE WOUND and of the HIGHEST GRADE OF INSULATION.

SIZES: 25, 40, 60, 100 Lamps' Capacity.

THE ARC LAMPS for use with these machines are of superior design, neat in appearance, simple and durable mechanism.

PRICES:

LAMPS' CAPACITY:	PRICE:
25	$1,250.00
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These Prices Include Generator, Lamps and Switchboard Instruments.

LAMPS SOLD SEPARATELY, $17.50 EACH.

Generators and lamps will operate on existing circuits.

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Westinghouse Electric & Manufacturing Co.,

Pittsburgh, Pa.

Important to Lighting Stations!

OUR NEW:

ALTERNATING CURRENT INDICATORS

Are now ready. Before purchasing elsewhere send for our Supplementary Catalogue which contains the prices and description of the above instruments, and also a list and prices of other ***new instruments*** of our manufacture.

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We are prepared to furnish first-class telephone receivers in quantities at very low prices.

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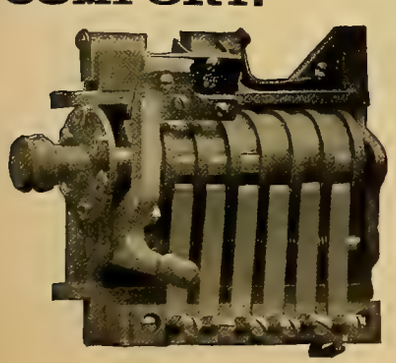

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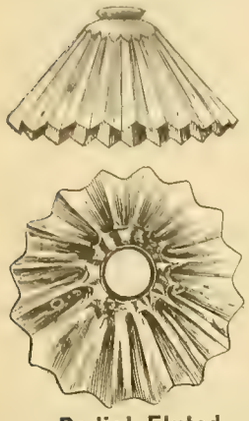

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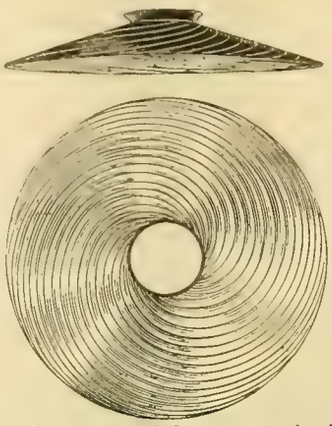

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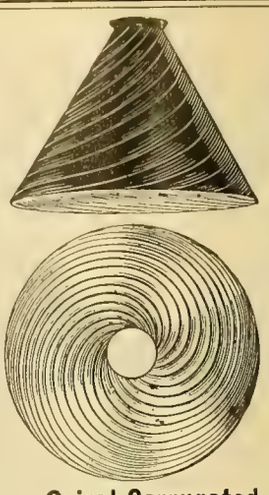

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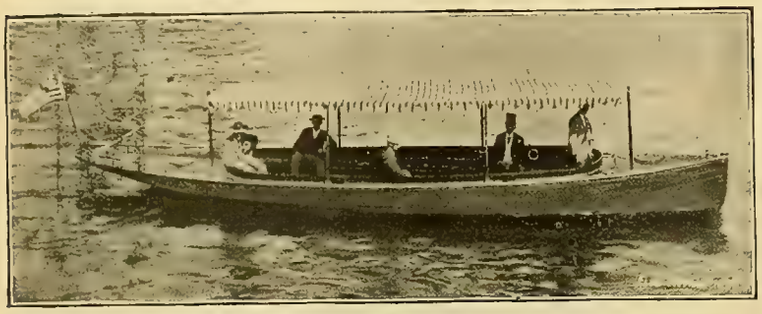

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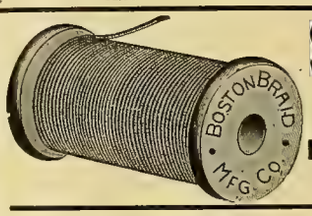

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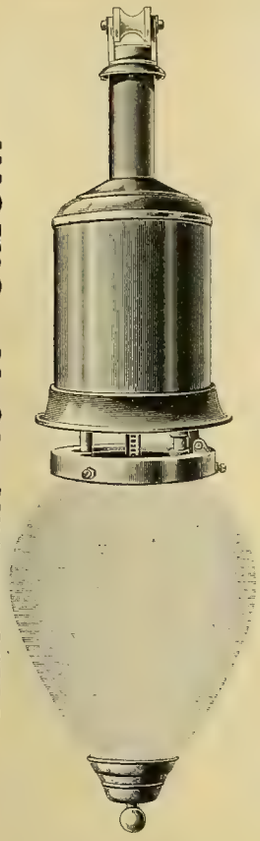

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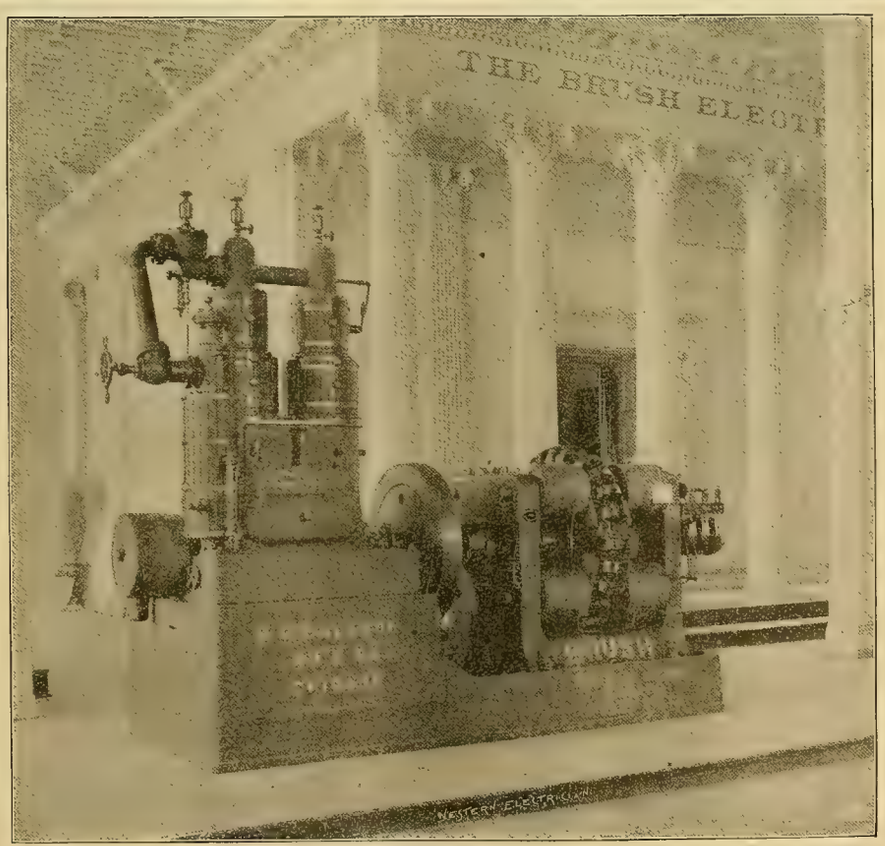

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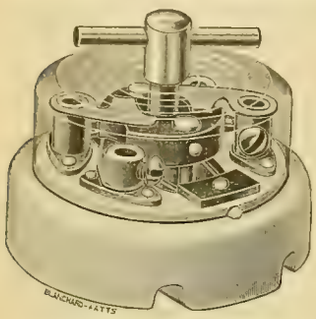

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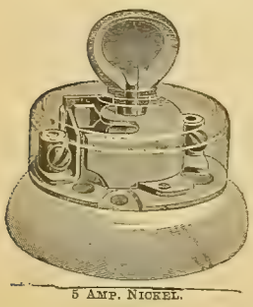

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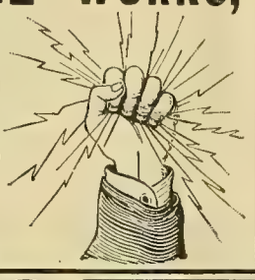

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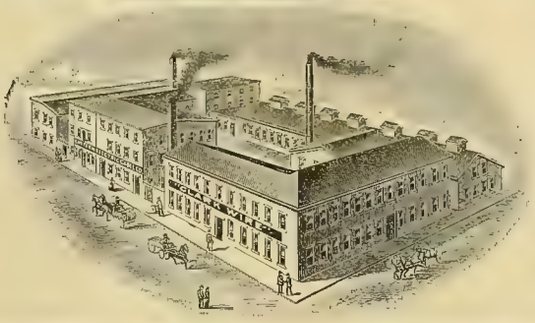

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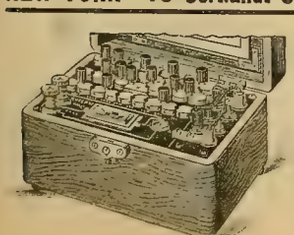

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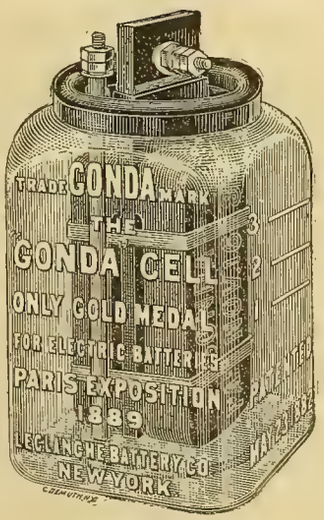

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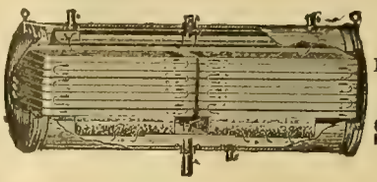

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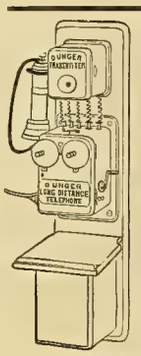

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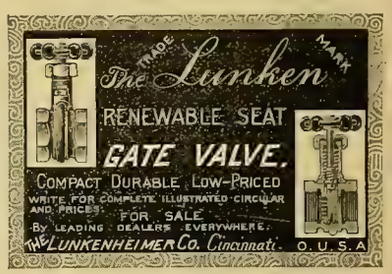

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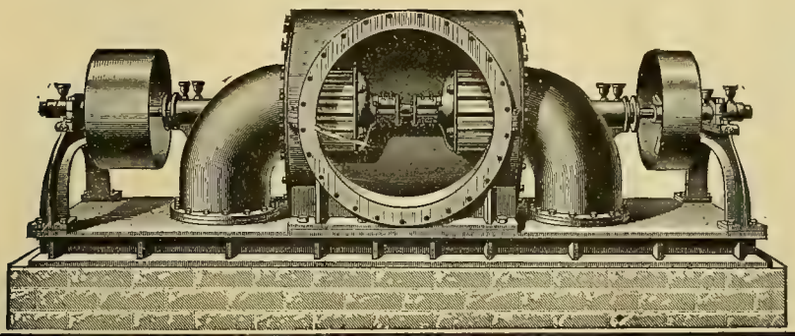

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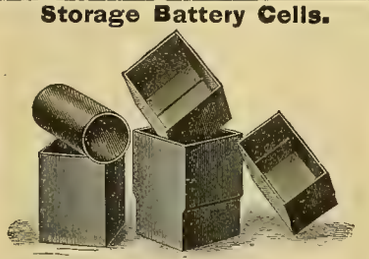

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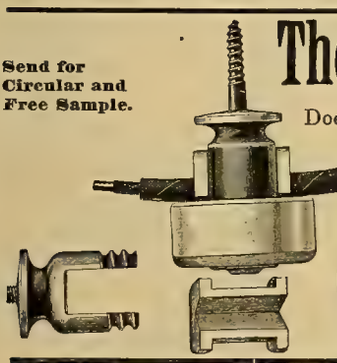

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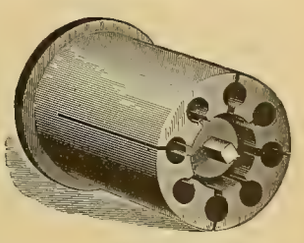

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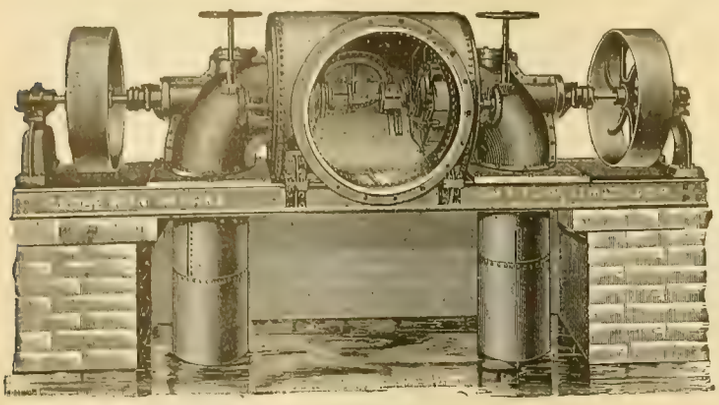

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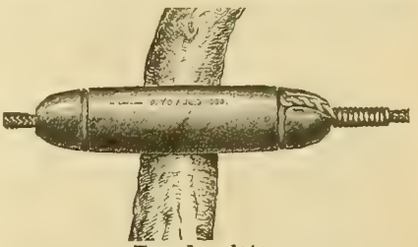
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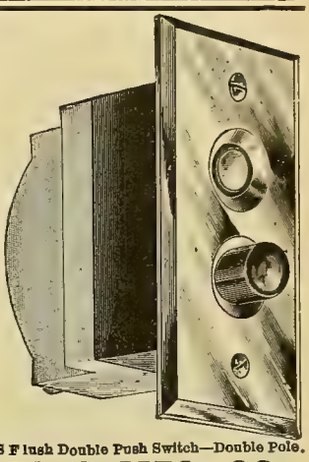
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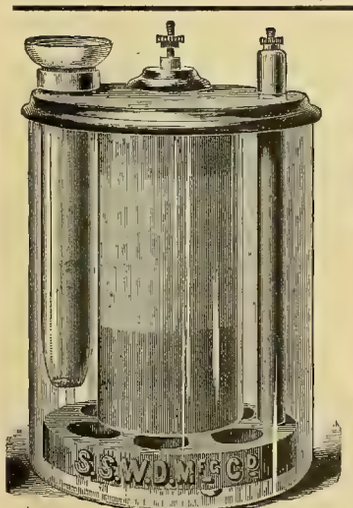

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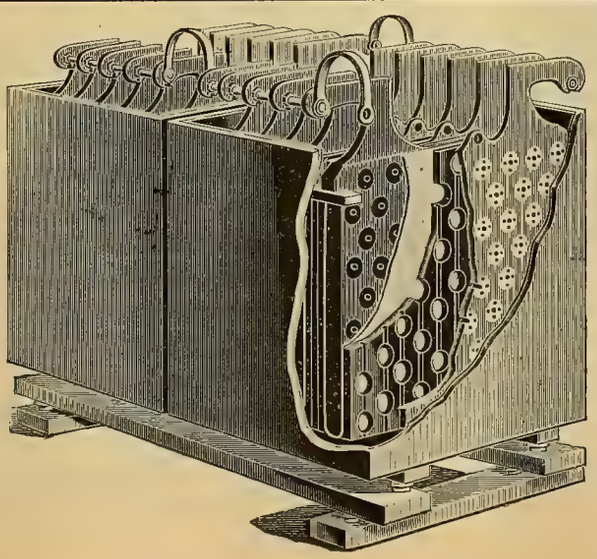

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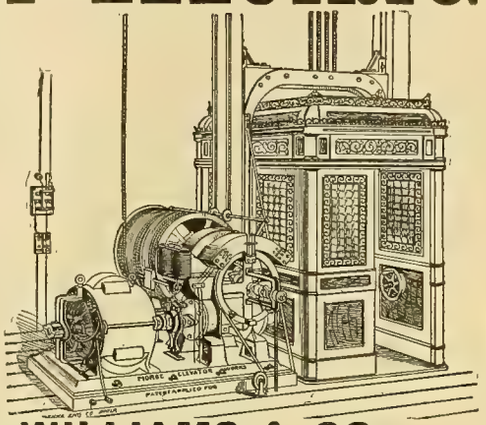

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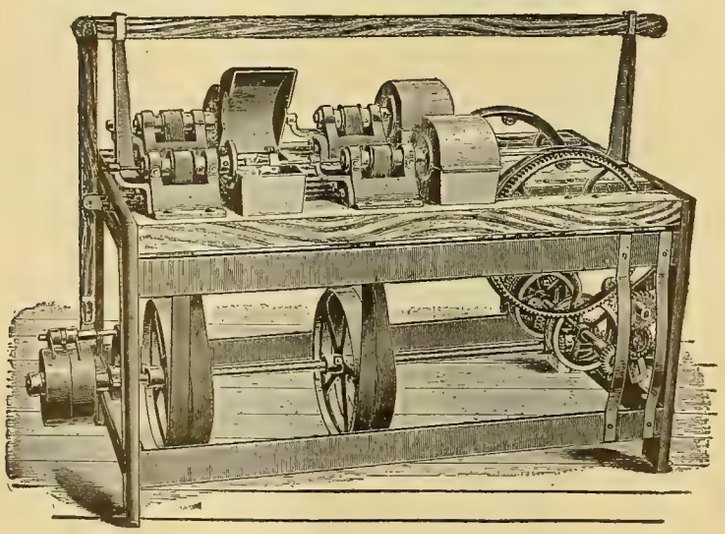

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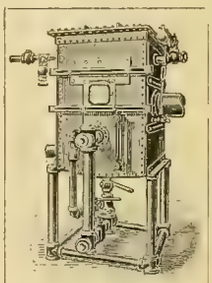

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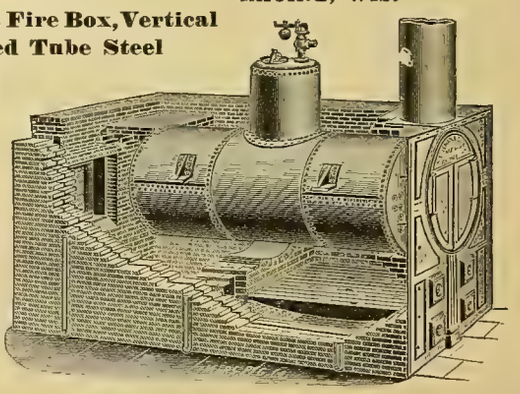

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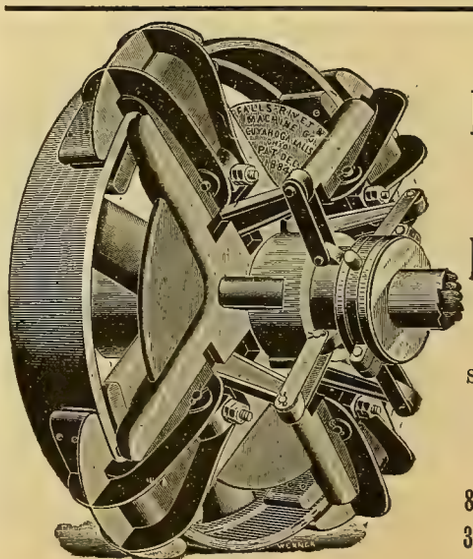

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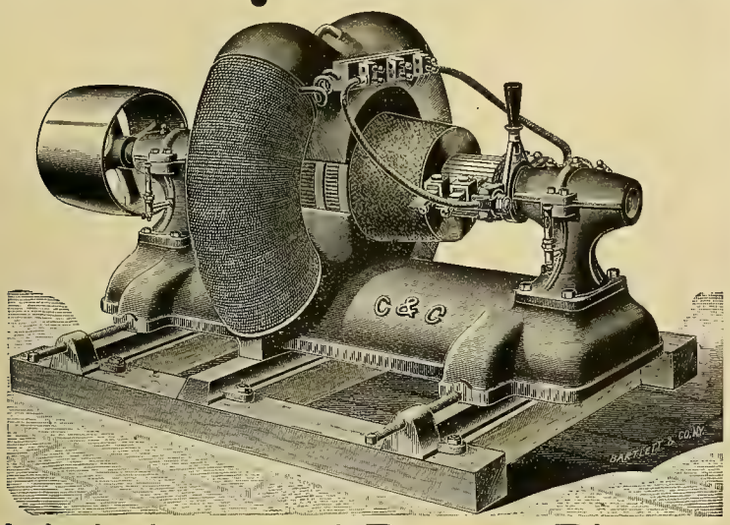

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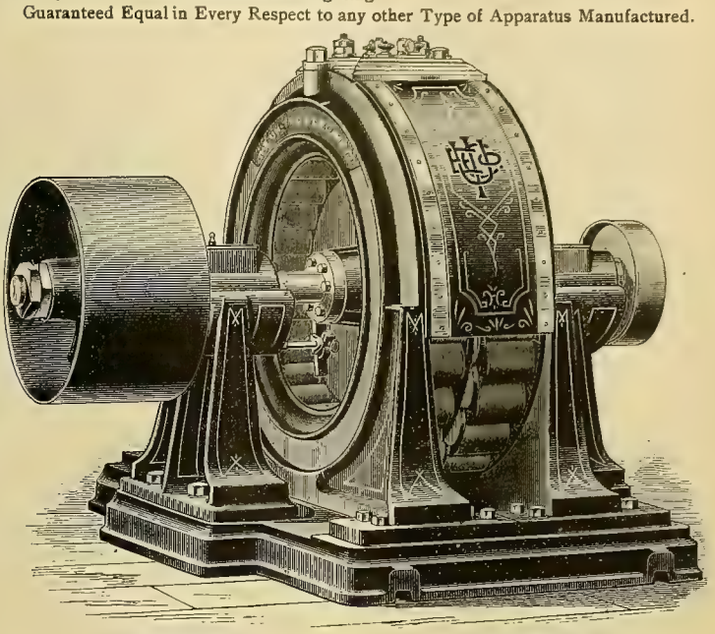

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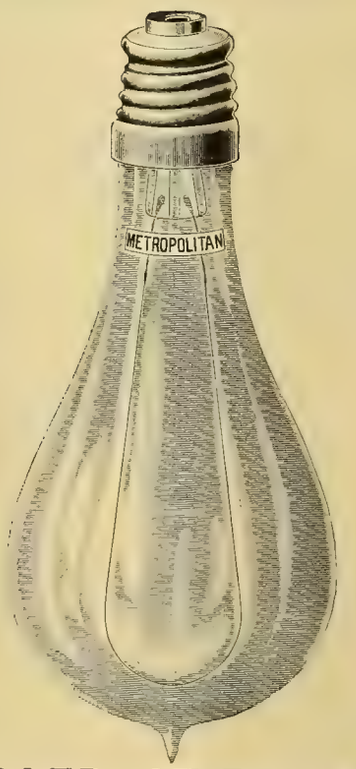

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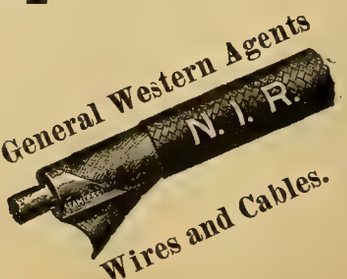

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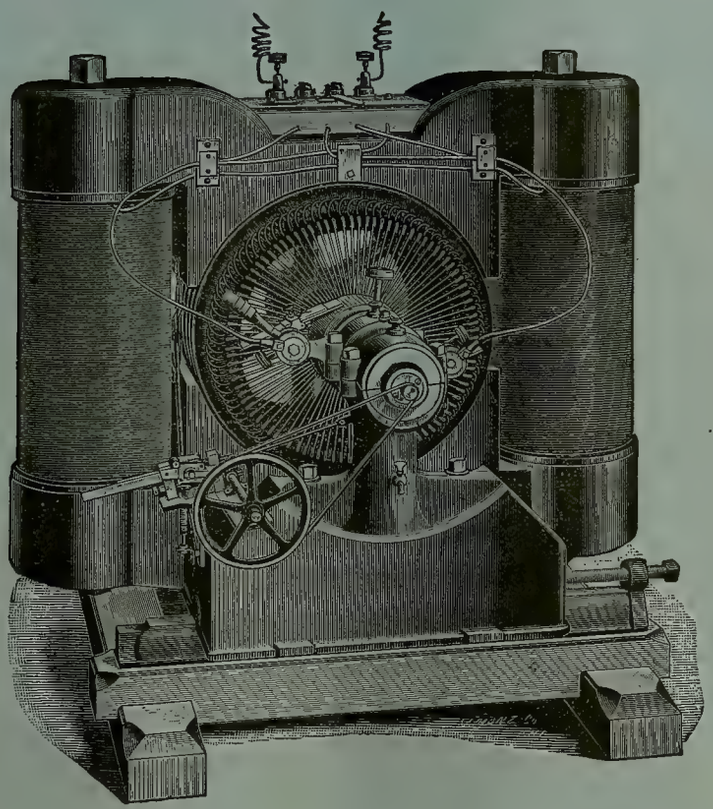

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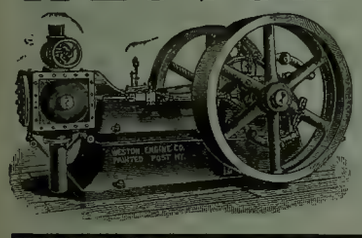

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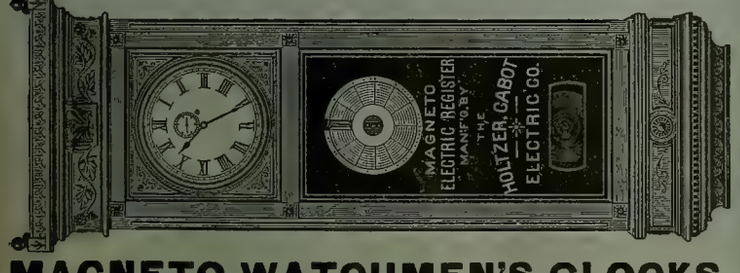

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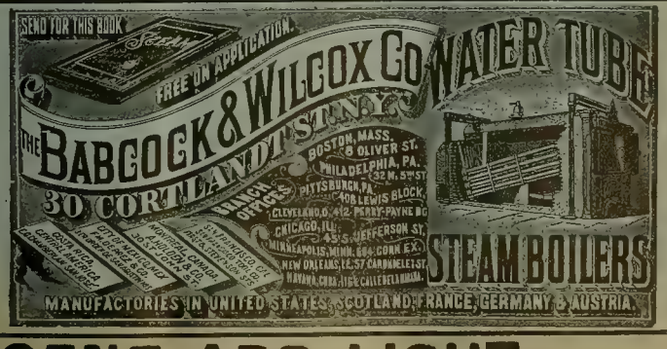

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Carbons, Points & Plates.
Central Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co
Western Electric Co.

Car-Heaters, Electric.
Consolidated Car-Heating Co.

Clutches, Friction.
Falls Rivet & Machine Co.
Lake, J. H. & D. Co.
Link Belt Machinery Co.

Construction & Repairs.
Adams, W. L. & Co.
Allen-Hussey Co.
Amstutz, N. S.
Andrews & Haschke.
C. & C. Electric Co.
Capitol Model & Mach. Wks
Comstock, Louis K.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co
Mather Electric Co.
Osburn, Harry G.
Pullman Electric Co.
Stone, O. M.
Wirt, Chas.

Contractors and Electric Light Plants.
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C. & C. Electric Co.
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Clark Electric Co.
Colburn Electric Mfg. Co.
Complete Elec. Const. Co.
Comstock, Louis K.
Fort Wayne Electric Co.
General Electric Co.
Great Western Mfg. Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co
Mather Electric Co.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Stone, O. M.
United Elec Improvement Co
Waddell-Entz Company.
Westinghouse Elec & Mfg. Co.
Western Electric Co.

Copper.
Law Battery Co.
Miamisburg Electric Co.

Copper Wires.
Adams, W. L. & Co.
American Electrical Works.
Bernard Co., The E. G.
Bishop Gutta Percha Co.
Brixey, W. R.
Bunnell & Co , J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Underg. Cable Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.
Woodruff & Co., C. E.

Cross-Arms, Pins and Brackets.
Adams, W. L. & Co.
Anderson, Albert & J. M.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Taylor, Dee & Mack.

Cut-Outs and Switches.
Adams, W. L. & Co.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Cutter Electrical & Mfg. Co.
Cutter, Geo.
Electric Appliance Co.
Electric Selector & Signal Co.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Iona Mfg. Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Perkins Elec. Switch Mfg. Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Washington Electric Co.
Western Elec. Supply Co.

Desk Lights.
McLeod, Ward & Co.

Dynamos.
Brush Electric Co.
C. & C. Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Fort Wayne Electric Co.
General Electric Co.
Great Western Mfg. Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
McMillan, Hugh.
Rose Elec. Light Supply Co.
Standard Electric Co.
United Elec Improvement Co
Waddell-Entz Company.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Electric Railways.
Brush Electric Co
Complete Elec. Const. Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Complete Elec. Const. Co.
Comstock, Louis K.
Merrill, Frederick L.
Monrath, Gustave
Osborne Steam Eng. Co.
Osburn, Harry G.
Stone, O. M.
Wirt, Chas.

Electrical Instruments.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Cutter, Geo.
Electric Appliance Co.
General Electric Co.
Great Western Mfg. Co.
Greeley & Co., The E. S.
Iona Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
McMillan, Hugh.
Queen & Company, Incorp.
Taylor, Dee & Mack.
Van Nuis, C. S.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.
Wirt, Chas.

Electrical Specialties.
Andrews & Haschke.
Capitol Model & Mach. Wks.
Electric Appliance Co.
Holtzer-Cabot Electric Co.
Iona Mfg. Co.
McLeod, Ward & Co.
Washington Electric Co.

Electroliers, etc.
Baggot, E.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Murray & Co., Jas. J.
Phœnix Glass Co.

Electro-Plating Mach'y.
Colburn Electric Mfg. Co.

Elevators, Electric.
Morse, Williams & Co.

Engines, Steam.
Ball & Wood Co., The.
Ball Engine Co.
Case, J. T. Engine Co.
Freeman Sons Mfg. Co.
Weston Engine Co.

Fan Outfits.
Diehl & Co.

Fibre.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

Fire Alarms.
Western Electric Co.

Fuel Economizers.
Fuel Economizer Co.

Fuse Wire.
Electric Appliance Co.
Independent Electric Co.

Gas Lighting, Electric.
Holtzer-Cabot Electric Co.

Gears.
Grant, Geo. B.

General Elec. Supplies.
Adams, W. L. & Co.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Central Electric Co.
Colburn Electric Mfg. Co.
Cutter Electrical & Mfg. Co.
Cutter, Geo.
Electric Appliance Co.
Great Western Mfg. Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Holtzer-Cabot Electric Co.
Iona Mfg. Co.
Law Battery Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
McMillan, Hugh.
Queen & Co., Incorp.
Sioux City Elec. Supply Co.
Taylor, Dee & Mack.
Turnquist, C. M.
Western Elec. Supply Co.
Woodruff & Co., C. E.

Globes and Electrical Glassware.
Baggot, E.
Gleason E. P Mfg. Co.
Hemingray Glass Co.
Murray & Co., Jas. J.
Phœnix Glass Co.

Graphite Specialties.
Dixon Crucible Co., Jos.

Hard Rubber Goods.
Newton Rubber Co.

Insulators and Insulating Materials.
Adams, W. L. & Co.
Anderson, Albert & J. M.
Andrews & Haschke.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Great Western Mfg. Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Moore, Alfred F.
Munsell & Co., Eugene.
McLeod, Ward & Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.
Vulcanized Fibre Co.
Western Elec. Supply Co.

Insulated Wires and Cables—Magnet Wire.
Adams, W. L. & Co.
American Electrical Works.
Bishop Gutta Percha Co.
Brixey, W. R.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Cutter, Geo.
Eastern Electric Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
McMillan, Hugh.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Son's Co., J. A.
Standard Und. Cable Co.
Taylor, Dee & Mack.
Waddell-Entz Company.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.
Woodruff & Co., C. E.

Lamps, Incandescent.
Am. Electric Mfg. Co.
Beacon Vacuum Pump & Electrical Co.
Bernstein Electric Co.
Buckeye Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Great Western Mfg. Co.
Lasell & Co., Edw.
Mather Electric Co.
Metropolitan Electric Co.
New York and Ohio Co.
New York Electric Co.
Royal Arc Electric Co.
Taylor, Dee & Mack.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Wirt Chas.

Magnet Wire.
(See Insulated Wires.)

Mica
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Boston Motor Co.
Brush Electric Co.
C. & C. Electric Co.
Colburn Electric Mfg. Co.
Day-Moberg Elec. Co.
General Electric Co
Great Western Mfg. Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
McMillan, Hugh.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Waddell-Entz Company.
Westinghouse El. & Mfg. Co.

Paints.
Standard Paint Co.

Patents.
Stocking, E. B.

Phosphor Bronze.
Phosphor Bronze Sm. Co., Ltd.

Platinum.
Baker & Co.

Porcelain.
Empire China Works.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electric Appliance Co
Metropolitan Electric Co

Rheostats.
General Electric Co.
Washington Electric Co.

Sal Ammoniac.
Innis & Co.
Klipstein, A.
Law Battery Co.

Second-Hand Electrical Machinery.
Gregory, Chas. E. Co.
Rose Elec. Lt. Supply Co.

Silk Braid.
Boston Braid Mfg. Co.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co. Incorp.
Whitney Elec. Instrument Co

Steam Heating.
Webster & Co., Warren.

Steam Pumps.
Worthington, Henry R.

Storage Batteries.
Accumulator Co., The
Bradbury-Stone Elec. S. Co.
Day-Moberg Elec. Co.
Elec-Power Storage Co.
Hubbard & Co., Wm.
Electric Storage Battery Co.
Pumpelly-Sorley S. B. Co.

Stoves, Electric.
Consolidated Car-Heating Co.

Street Cars.
Brill, J. G. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.

Telegraph Apparatus.
Central Electric Co.
Electric Appliance Co.
Electric Selector & Signal Co.
Greely & Co., The E. S
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

Telephones.
D'Unger Elec. Tel. Mfg. Co.
Lasell & Co., Edw.
Manhattan Elec. Sup. Co.
Western Electric Co.
Western Tel. Const. Co.

Transformers.
Hornberger Elec. Mfg. Co.
Stanley Electric Mfg. Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Tools.
Lunkenheimer Co., The.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stilwell & Bierce Mfg. Co.

Universities.
Correspondence School of Technology.
Institute of Technology.

Valves.
Lunkenheimer Co., The.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.
Smith, S. Morgan.

Wire, Bare.
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co
National India Rubber Co
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons' Co., J. A.
Standard Und. Cable Co.
Taylor, Dee & Mack.

1894. MARCH. 1894.

SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.
				1 (60)	2 (61)	3 (62)
4 (63)	5 (64)	6 (65)	7 (66)	8 (67)	9 (68)	10 (69)
11 (70)	12 (71)	13 (72)	14 (73)	15 (74)	16 (75)	17 (76)
18 (77)	19 (78)	20 (79)	21 (80)	22 (81)	23 (82)	24 (83)
25 (84)	26 (85)	27 (86)	28 (87)	29 (88)	30 (89)	31 (90)

MOON'S PHASES. NEW MOON. 7th FIRST QR. 14th FULL MOON. 21st LAST QR. 29th

JANUARY

SU	M	TU	W	TH	F	SA
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

FEBRUARY

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

MARCH

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

APRIL

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

MAY

SU	M	TU	W	TH	F	SA
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JUNE

SU	M	TU	W	TH	F	SA
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

COMBINATION CALENDAR TABLET
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JULY

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

AUGUST

SU	M	TU	W	TH	F	SA
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

SEPTEMBER

SU	M	TU	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

OCTOBER

SU	M	TU	W	TH	F	SA
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

NOVEMBER

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

DECEMBER

SU	M	TU	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

DAYS IN MARCH

When You Should Send Us Your Order For

ALL ELECTRICAL SUPPLIES.

Send for Catalogue if you have not one already.

Low Insulation = High Insurance.
High Insulation = Low Insurance.

INTERIOR CONDUITS AND OKONITE WIRES GIVE HIGH INSULATION, HENCE

Interior Conduits + Okonite Wire = Low Insurance.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., Chicago.

SPECIAL AGENTS: { CATE CITY ELECTRIC CO., KANSAS CITY, MO.
SOUTHERN ELECTRICAL SUPPLY CO., ST. LOUIS.

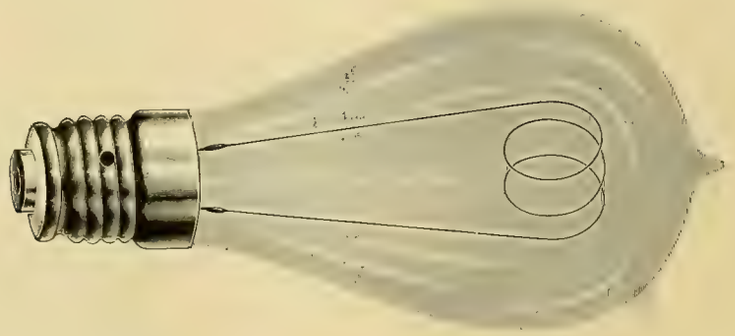
The powers of man have not been exhausted. Nothing has been done by him that cannot be better done.

There is no effort of science or art that may not be exceeded.

What the productive genius of the 20th century may evolve in the way of an Incandescent lamp we know not

TO-DAY.

THE Buckeye LAMP



Yes, we HAVE reduced our prices, but NOT at the expense of QUALITY.

We manufacture but ONE, THAT A HIGH GRADE lamp. Our prices are as LOW as those named for CHEAPLY CONSTRUCTED lamps which in quality are "so middling, BAD were better." Product of this kind is a LUXURY we cannot afford.

Shipments are being made from CHICAGO STOCK.

"Special Coiled Filament."

"Individuality and Beauty of Illumination."

"Pure WHITE Light."

"Absence of Bulb Discoloration."

"Satisfactory Length of Life."

"Low COST of Operation."

"Prompt Shipment."

"FACTORY Prices to ALL."

These are SOME of our BUSINESS BRINGERS.

Is ACKNOWLEDGED to be the BEST that genius, skill and capital has yet produced.

Of COURSE you have heard that the injunction against this company was dissolved WITHOUT BOND. Our patrons therefore have nothing to fear from SUITS or THREATS on account of infringement.

The Buckeye Electric Co.

CHICAGO,
753 Monadnock Bldg.

FACTORY,
Cleveland, Ohio.

STORAGE BATTERIES, FOR TROLLEY LINES,

— AND —

Central Lighting Stations.

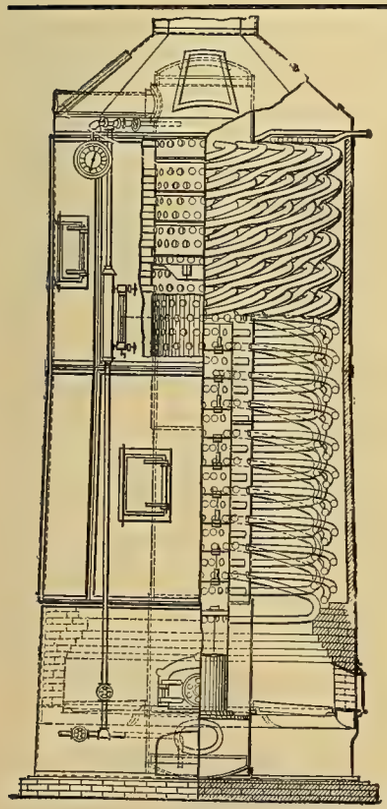
Properly Installed and Guaranteed.

REQUIRE	SECURE
Less Investment,	Greater Economy,
Less Power,	Constant Load,
Less Labor.	Constant Voltage.

[Our 30 H. P. cell (12,000 ampere hours) occupies one half cubic yard.]

The Accumulator Company,

224 Chestnut Street, Philadelphia.



THE "MORRIN" CLIMAX STEAM GENERATOR

Has been acknowledged by all practical minds, the Best Boiler Invented.

A TESTIMONIAL.

FROM THE LABORATORY OF THOMAS A. EDISON.

ORANGE, N. J., February 6, 1894.

CLONBROCK STEAM BOILER WORKS, Brooklyn, N. Y.

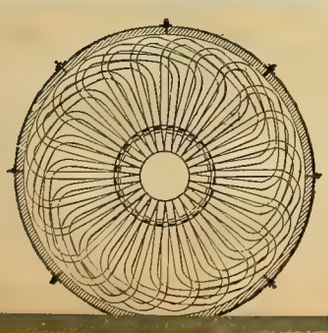
Dear Sirs:—Your letter of 30th ultimo is received. I have a Climax Boiler, and it is giving great satisfaction. Taking everything in consideration, it is, in my opinion, practically and theoretically, the best boiler so far invented. Yours truly,

THOS. A. EDISON.

A Partial List of Recent Installations.

The Westinghouse Electric Company,	Pittsburg.
The Brush Electric Co.,	Baltimore.
Chicago Arc-Light and Power Co.,	Chicago.
The Newark Electric Light and Power Co.,	Newark, N. J.
The Edison Electric Ill. Co.,	Brooklyn.
Essex County Electric Co.,	Orange, N. J.
New Britain Electric Co.,	New Britain, Conn.
Safety Electric Light Co.,	New York.
Thomson-Houston Electric Co.,	New York.
United Electric Light and Power Co.,	New York.

These Boilers built in units from 50 to 1500 H. P.



MANUFACTURED BY

CLONBROCK STEAM BOILER WORKS,

Court Creamer, Lorraine and Smith Sts.,

Send for New Catalogue. BROOKLYN, N. Y.

THE HOWARD SYSTEM.

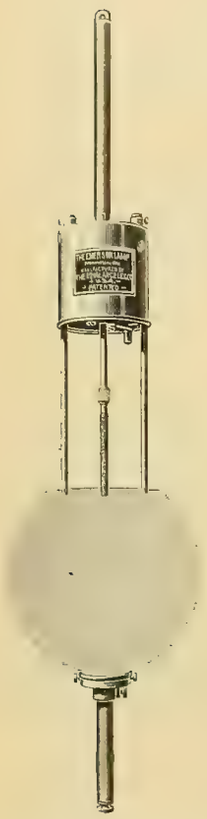
"THE NEW INCANDESCENT ARC LIGHT."

PERFECT DISTRIBUTION OF LIGHT.

FOR ALL CIRCUITS.

COST OF TRIMMING REDUCED TO A MINIMUM.

APPURTENANCES CAN BE ATTACHED TO ANY MAKE OF ARC LAMP.

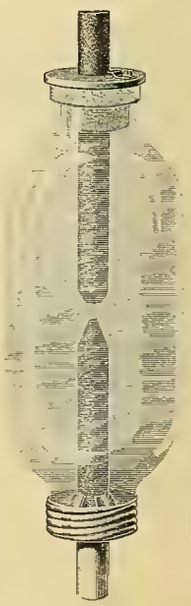


"The importance to the future of the electric lighting industry cannot be over-estimated." *The Electrical Engineer, New York.*

"The most efficient spark arrester presented."
C. M. GODDARD, Sec.,
International Underwriters' Ass'n.

"The best spark arrester that can be devised."
F. E. CABOT, Supt.,
Boston Board of Fire Und.

"Unqualified approval as a spark arrester."
C. M. GODDARD,
Treas.,
N. E. Ins. Exchange.



"A complete fire protector and practical apparatus."
A. C. DUNHAM,
Pres.,
Hartford Elec. Lt. Co.

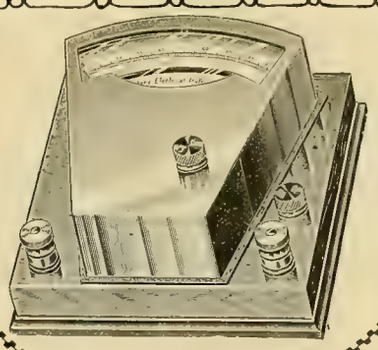
Life of one pair of 7/16 inch carbons over 100 hours

This system has been introduced in the City of Hartford, Conn. by the Connecticut Royal Arc Co., and has been in continuous operation on street and commercial circuits for the past five months. Merchants in the City of Hartford employing Arc Lights by adopting this appurtenance have been able to save 33⅓ per cent. from established rates made by the Hartford Board of Fire Underwriters.

The commercial advantages enjoyed when this equipment is adopted are many: Cleanliness, removal of anxiety in regard to fire and the necessity for trimming the lamp reduced to twelve times per year, where average lamp hours are employed.

THE ROYAL ARC ELECTRIC CO., U. S. A. 143 Liberty St., New York.

WIRES AND CABLES.



WHITNEY INSTRUMENT.

WIRES AND CABLES.

SPECIALTIES THAT LEAD.

In addition to the attractive line of Specialties that are here represented, our line of Electrical Supplies is

COMPLETE IN EVERY DETAIL.

We make a particular point of prompt shipments and careful, personal attention to orders, and look particularly after the interests of our customers.

Always give us an opportunity to make prices on any Supplies you may require. It is generally known that

WE MAKE PRICES TO SELL.

ELECTRIC APPLIANCE COMPANY,

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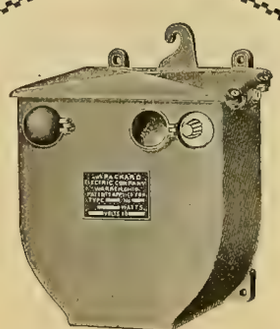

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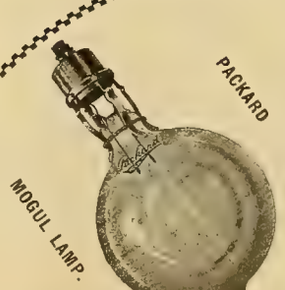

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FOR

ELECTRIC LIGHT

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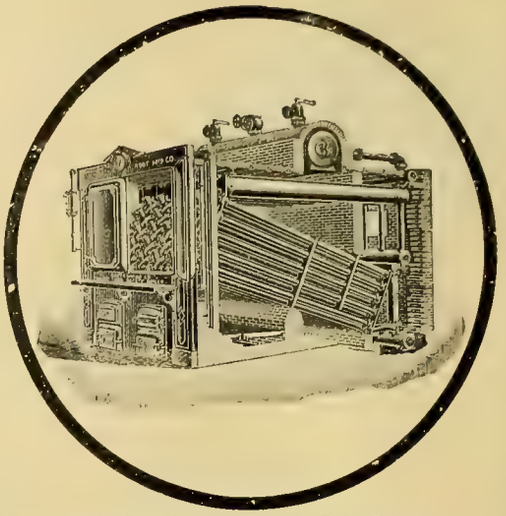

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Absolute Safety with Highest Possible Economy.

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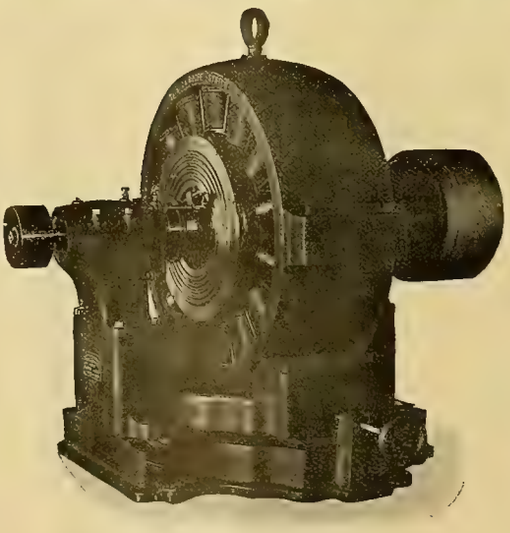

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HIT THE BULL'S EYE!

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OKONITE INSULATION ACKNOWLEDGED BY ALL EMINENT ELECTRICIANS TO BE **THE BEST.**

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Electric-Power Storage Company,

Manufacturers of

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No Short Circuiting; No Sulphating. Lowest Internal Resistance, Large Delivery, Highest Efficiency.

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SPECIAL CELLS FOR SURGICAL AND MEDICAL WORK.

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OFFICE: **COVINGTON, KY.**

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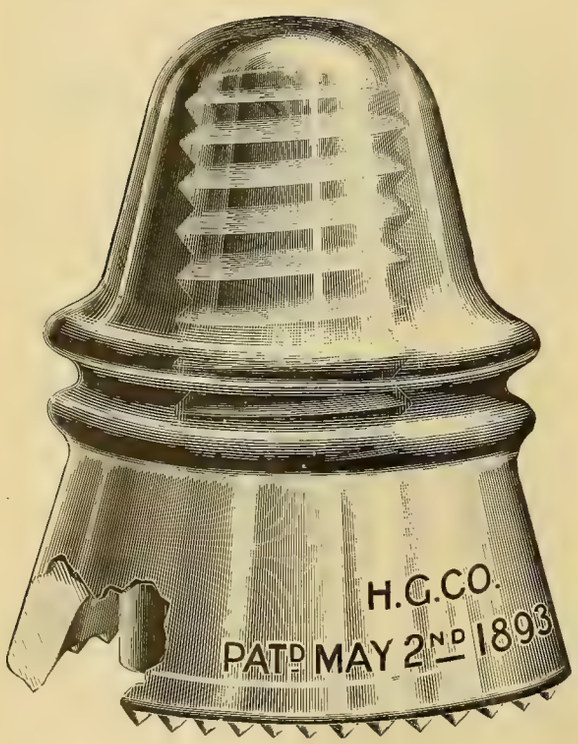

Standard Screw Glass Insulators, Floor Insulators,

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Arc Light Globes for All Systems,

Colored Glass Insulators to designate different currents.

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Send Model or Drawing and we will furnish estimates.

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Manufacturer of Kerite
Insulated Wires & Cables
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Dear Sir,

Replying to your enquiries.

I beg to state that it is now over two years since we ordered from your firm the 6000 feet of 18 Conductor Aerial Kerite Cable, for use in the Tunnel under the St. Clair River, between Sarnia Ont. and Port Huron Mich.

We have pleasure in stating that during the whole of this time, although the Cable has been continually subjected to the severe test of steam &c, it has given perfect satisfaction.

Yours truly,

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Received the only award at the World's Fair for "High Insulation, Excellence of Material, Durability and Reliability under the Most Exacting Conditions." Over 300 miles of 8-conductor ***Kerite*** Aerial Cable constructed for and now in use on the New York Central and Hudson River Railroad Co. ***The Longest Length of this class of Cable ever put in use.***

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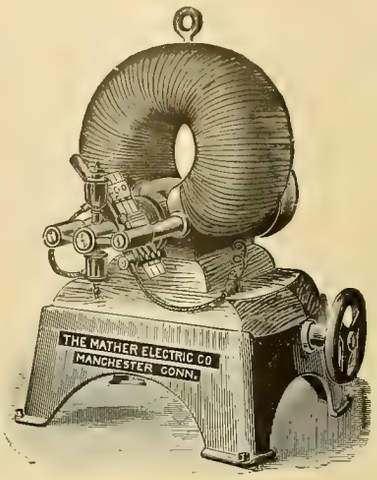
COMPLETE ELECTRICAL EQUIPMENTS FOR LIGHTING AND POWER PURPOSES.

DYNAMOS
FROM
50 to 3,000 Lights.

MOTORS
FROM
1 to 300 H. P.



Street Railway Generators
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Station Equipment
TO
500 K. W.

We shall, as for the past thirteen years, maintain our reputation as manufacturers of the most modern and reliable direct current apparatus that brains and money can produce.

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Don't make a Alternating Arc investigating

By Buying any Lamp before the

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Everything about it is of the very best. Brass Frame, Brass Shell, Brass Cap, Brass Rods. No tin or stovepipe iron. It combines unequaled simplicity with absence of all objectionable features heretofore present in alternating lamps. It is a **NON-STICKER** that central station men and lamp trimmers will be **STUCK** on because they don't have to **MONKEY** with it every few days, taking it down to clean and oil. Lamps for all systems. We guarantee every lamp. Write for prices.

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PATENTS ON
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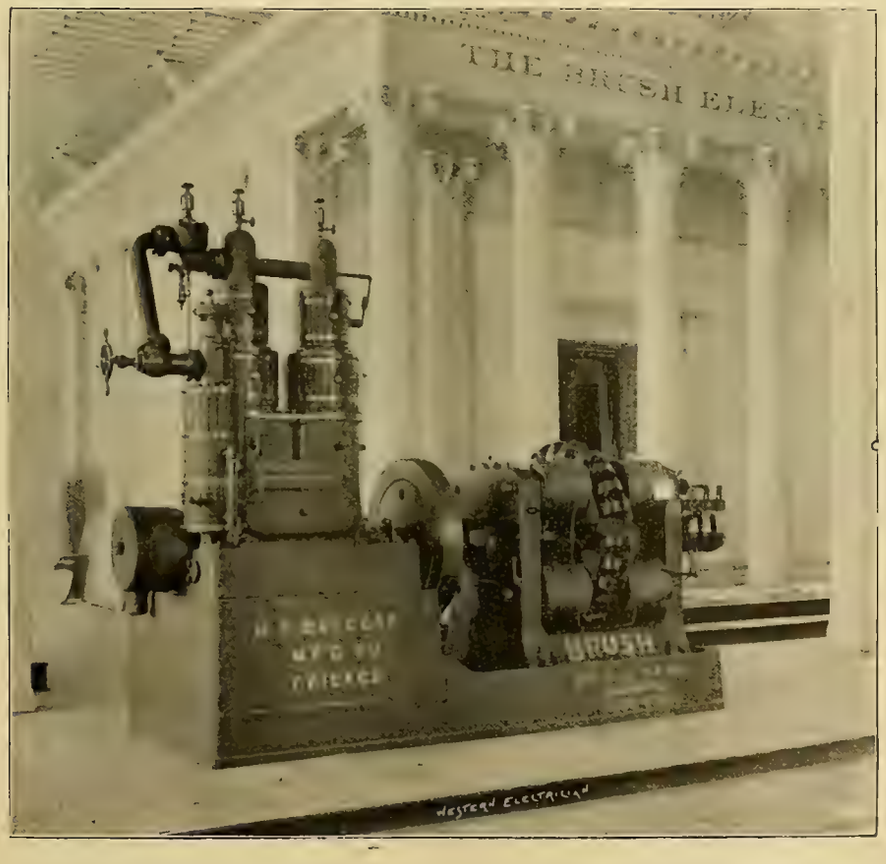
SUSTAINED BY SIXTEEN DECISIONS
OF U. S. COURT.

The Only Lamp for all Night Lighting.



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Arc Globes and Incandescent Shades.

We make a Specialty of these goods, and can always make prompt shipments.

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Railway Generators, Motors, Station Appliances, Line Supplies, Rail Bonds, Etc.

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Stationary Motors, (Constant Potential).

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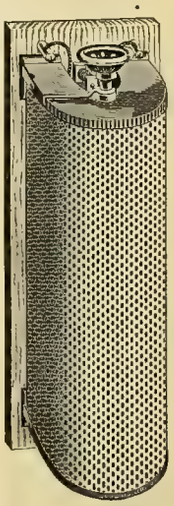
Rheostat and Stage Dimmer.



Contact made on wires direct instead of on segment face.

Changes from light to dark and vice versa, made perfectly even and gradual.

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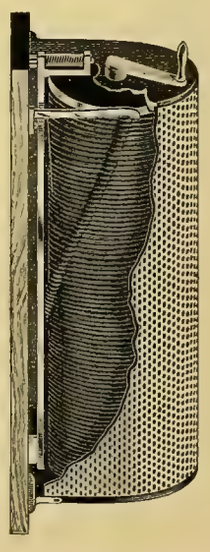

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Meissner's Focusing Lamp for photo-engraving and stereoscopic work has no equal.

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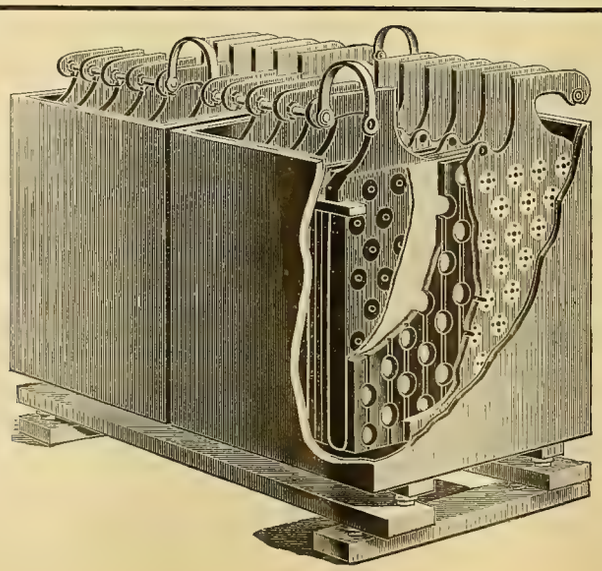

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Let us ship you a trial lot, which we **guarantee** as we represent.

All styles shipped **promptly**.

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Our complete outfit, including transmitter, receiver and signaling apparatus, will be ready for delivery after February 15th. These outfits will have an automatic circuit-changing device, which we guarantee is no infringement.

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Link Belt

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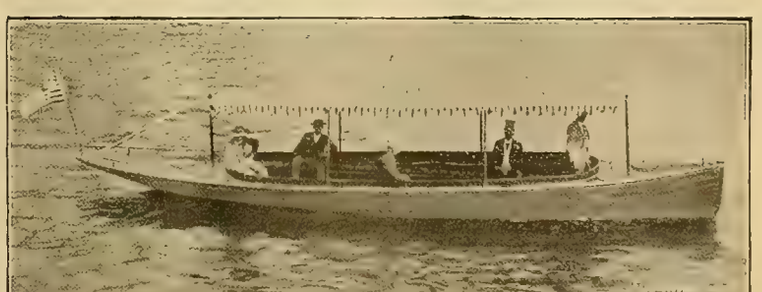
The "Ideal" Storage Battery

For all Classes of Work where Light and Power are Required.



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New Prices given on Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters

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This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.

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THE LOWEST PRICES!
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THE ARC LAMPS for use with these machines are of superior design, neat in appearance, simple and durable mechanism.

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These Prices Include Generator, Lamps and Switchboard Instruments.

LAMPS SOLD SEPARATELY, $17.50 EACH.

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TELEPHONES SOLD OUTRIGHT.
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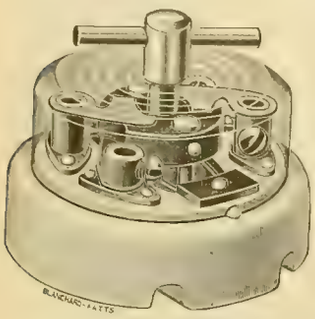

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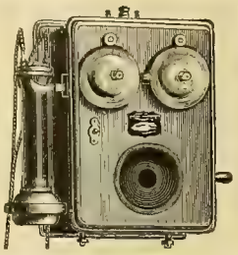

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The only Perfect Automatic Telephone Switch which does not infringe.

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Work Any Distance. No Infringement Whatever
No Battery Required. Satisfaction Guaranteed.

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But have your burned-out armature rewound by us with our

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New York Insulated Wire Co.,

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COMPETITION LINE WIRES, GRIMSHAW TAPES, AND SPLICING COMPOUND,

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High Electromotive Force. Small Internal Resistance.

LITTLE LIABILITY OF CARBON BREAKING IN SHIPMENT.
SUITABLE FOR BELLS AND GAS LIGHTING.

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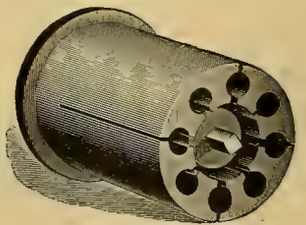

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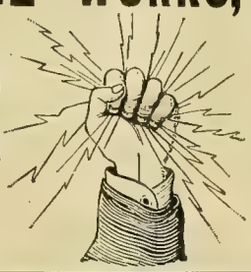
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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Standard Screw Glass Insulators, Floor Insulators,
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Send Model or Drawing and we will furnish estimates.

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For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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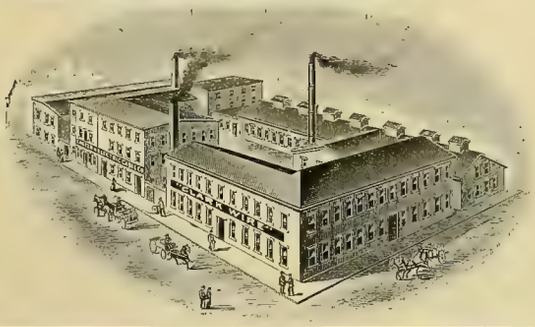

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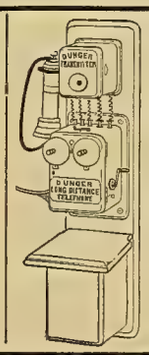

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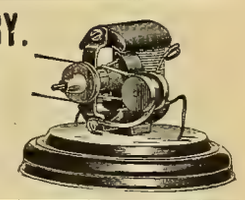

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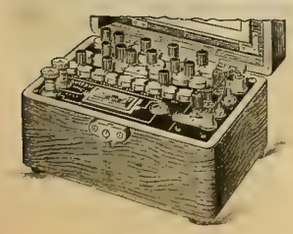

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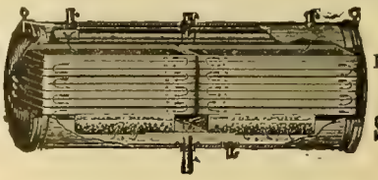

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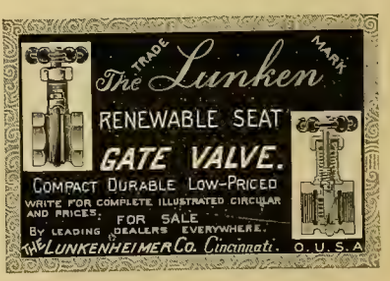

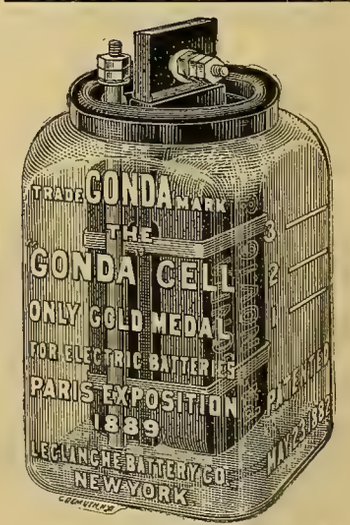

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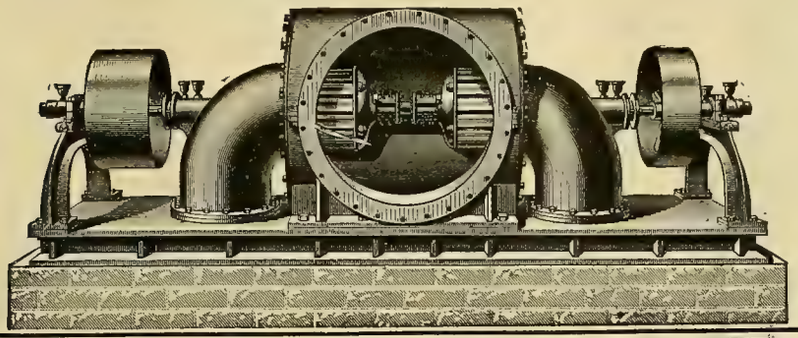

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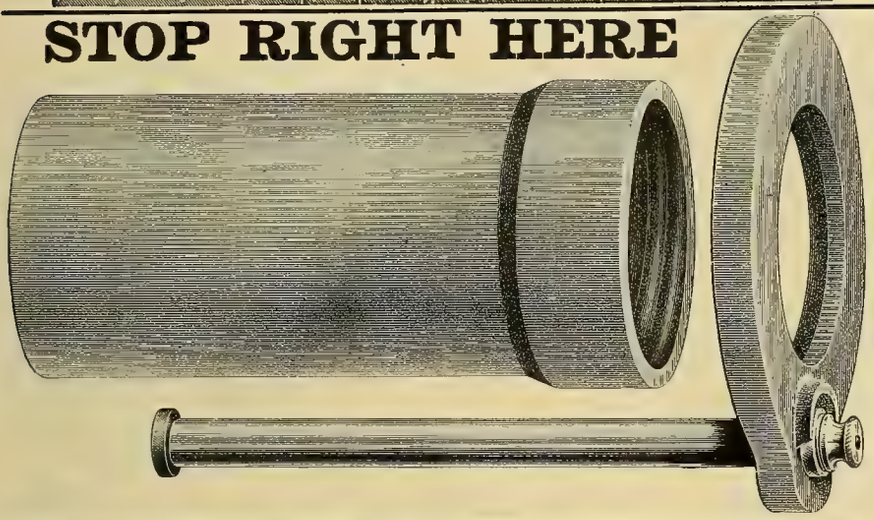
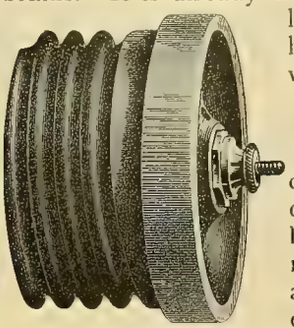


And take a look at the latest emanation from our brains. It is already well known throughout the land, but you may not have heard of it; therefore, we would say it is



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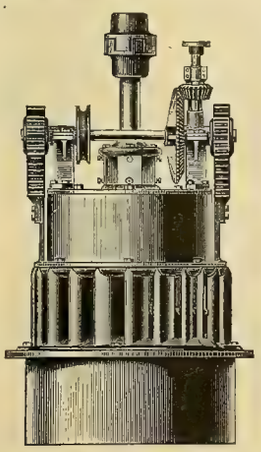

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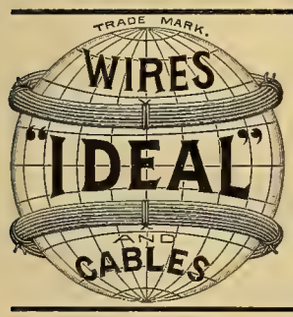

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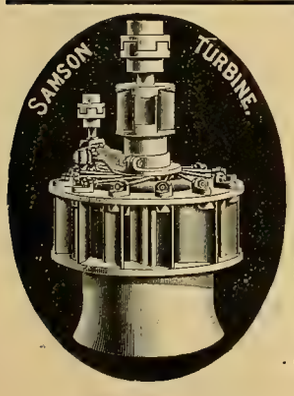

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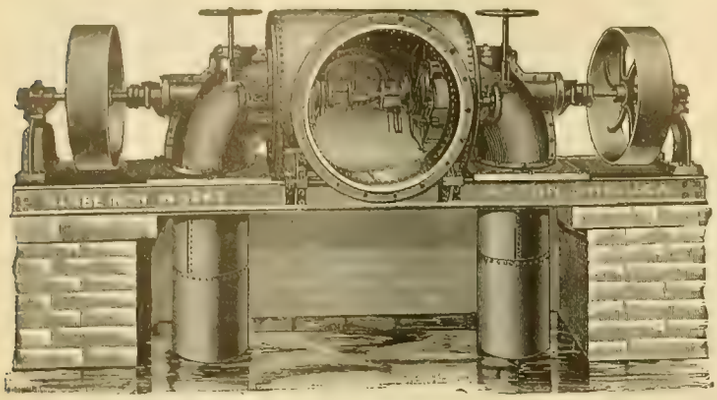

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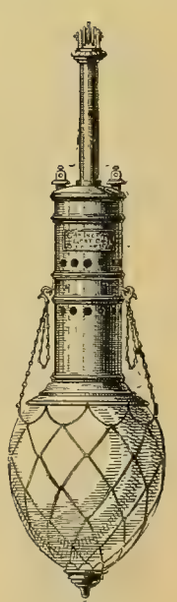

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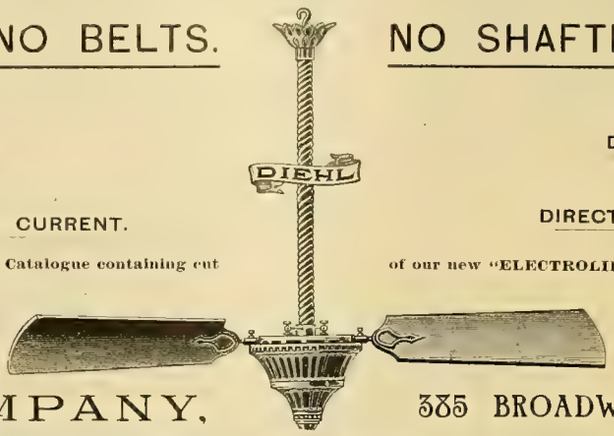

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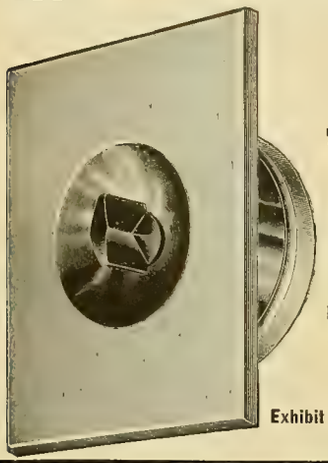

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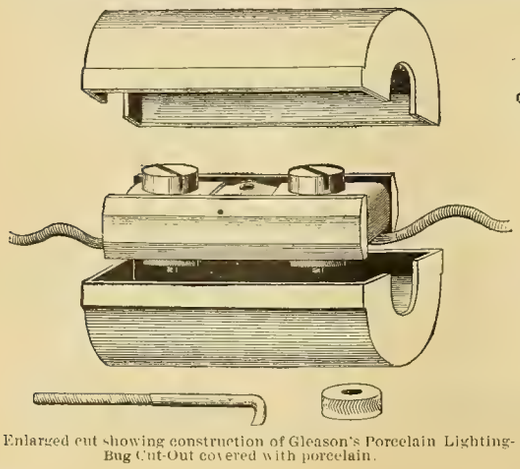

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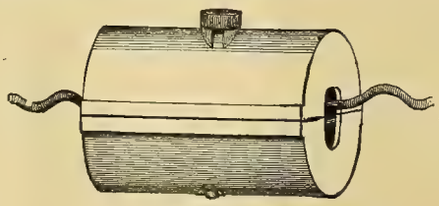

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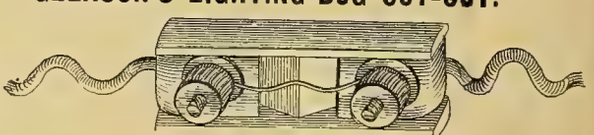

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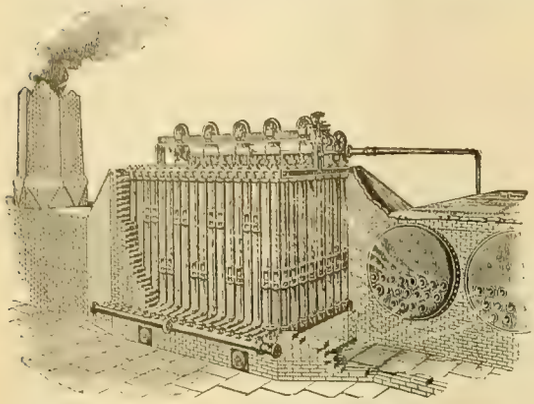

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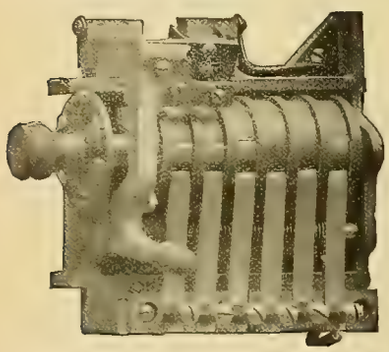

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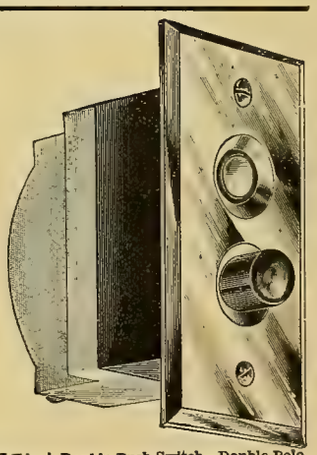

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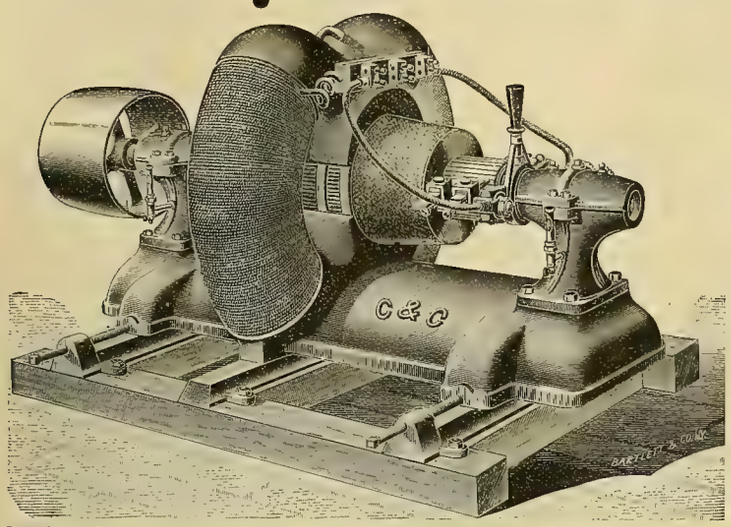

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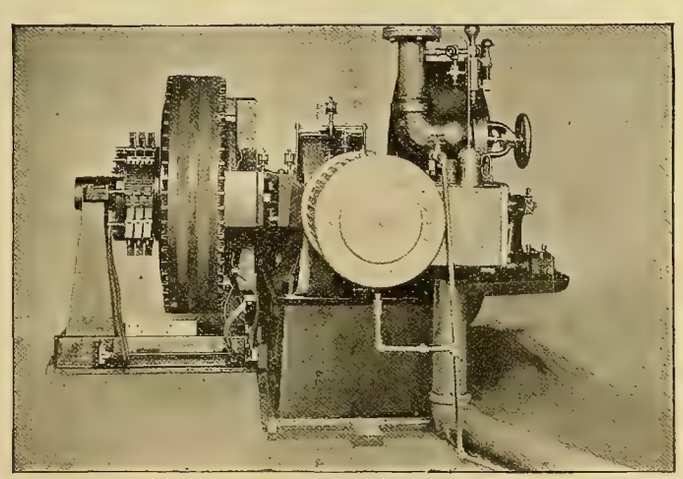

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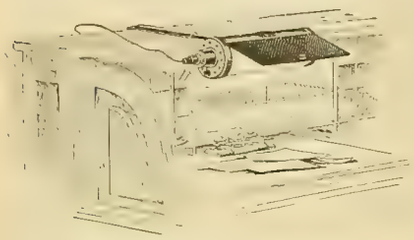

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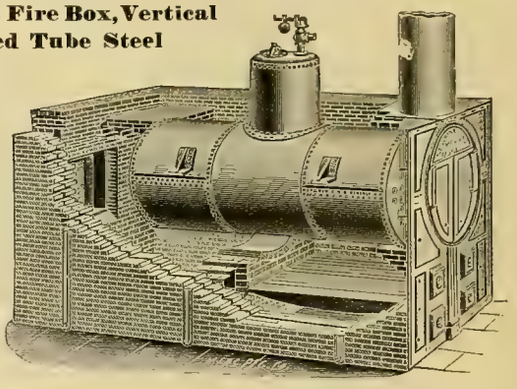

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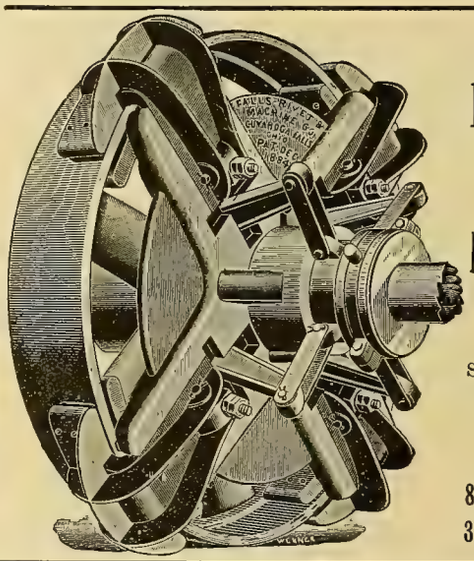

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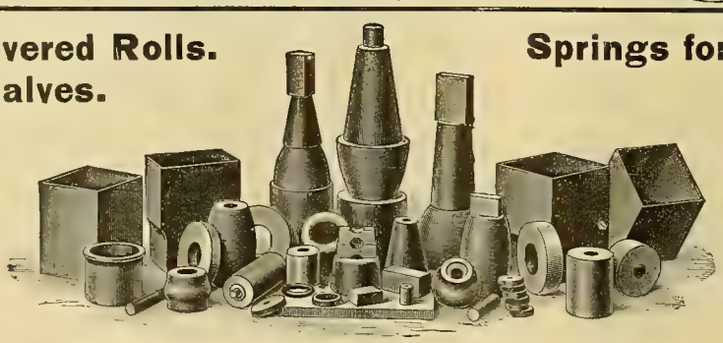

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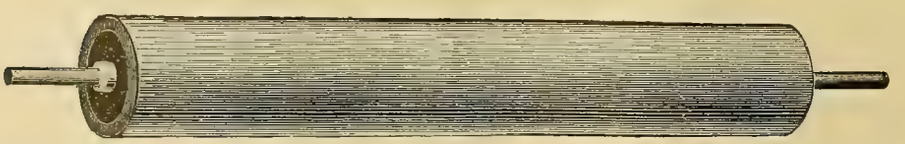

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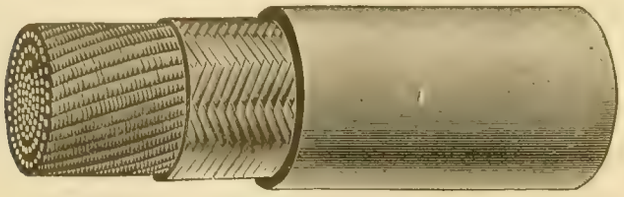

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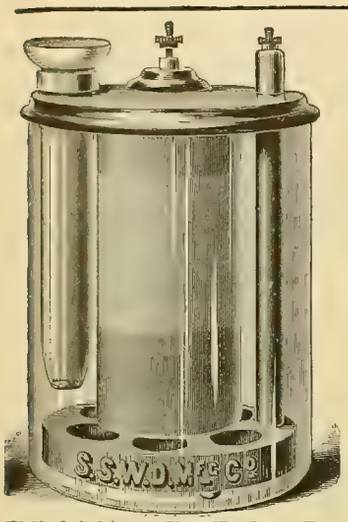

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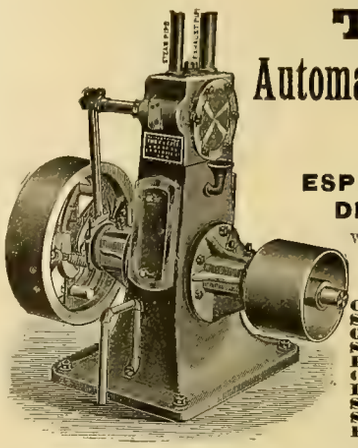

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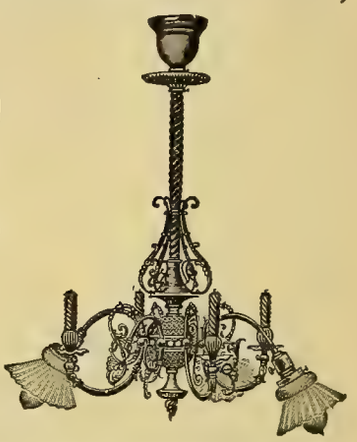

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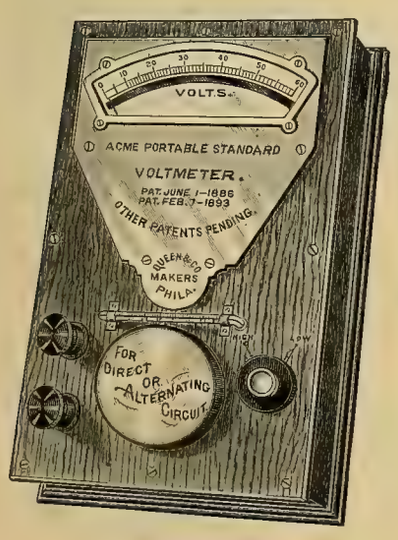

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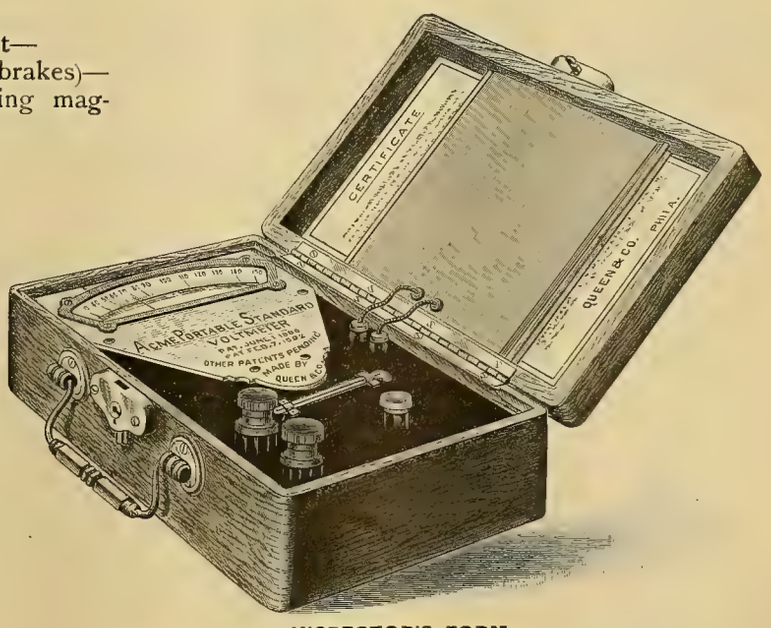

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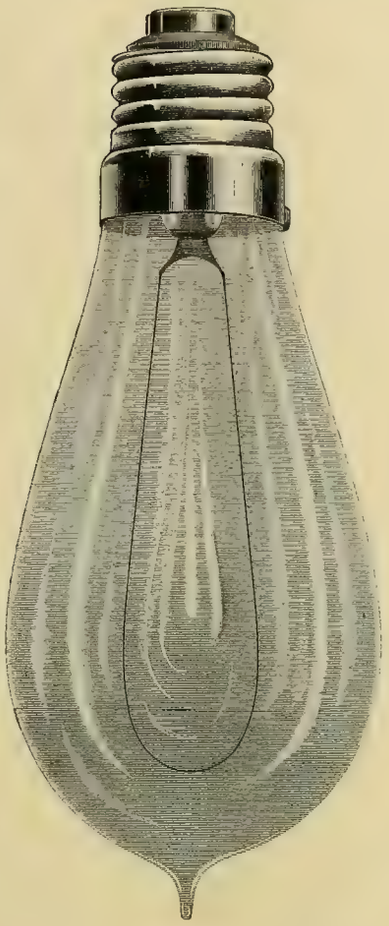

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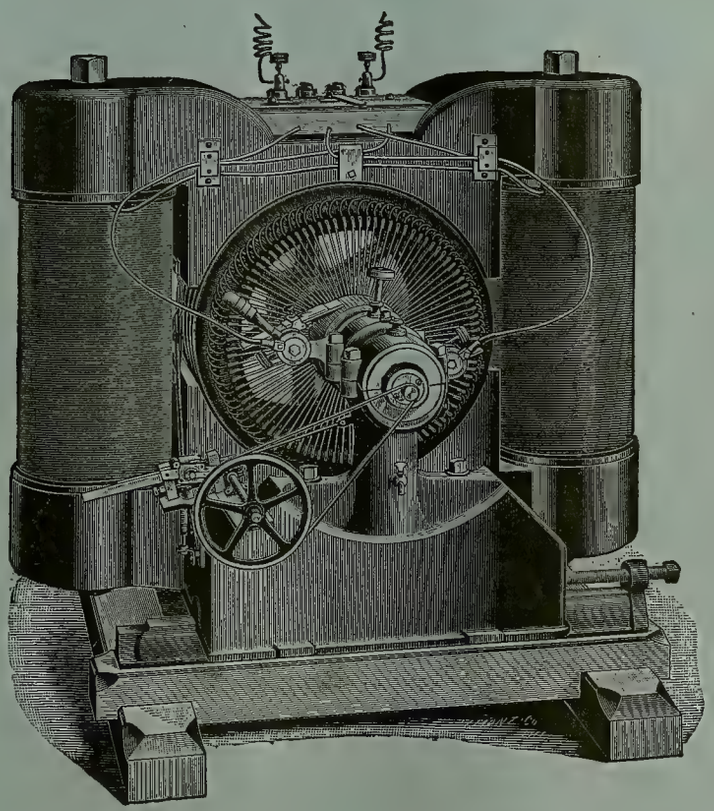

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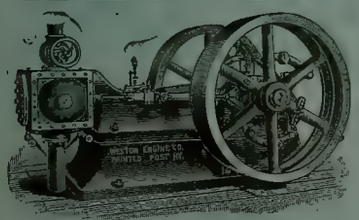

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Electric Storage Battery Co.

Adjusters Lamp
Dow Adjustable Lt. Co.

Annunciators.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Arc Lamps.
C. & C Electric Co.
Carter & Co., Geo. G.
Clark Electric Co.
Electric Appliance Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Great Western Mfg. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Royal Arc Electric Co
Siemens & Halske Elec. Co
Standard Electric Co.
Taylor, Dee & Mack.
Washington Electric Co
Westinghouse El. & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Central Electric Co.
Electric Appliance Co.

Armature Winders.
Andrews & Haschke.
Pullman Electric Co.

Batteries and Jars.
Accumulator-Co., The
Boston Motor Co.
Bradbury-Stone Elec S Co.
Bunnell & Co , J. H.
Carter & Co., Geo. G.
Central Electric Co.
Day-Moberg Elec. Co.
Electric Appliance Co.
Elec-Power Storage Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hemingray Glass Co.
Law Battery Co.
Leclanche Battery Co., The.
Manhattan Elec. Sup. Co.
McMillan, Hugh.
Metropolitan Electric Co.
Miamisburg Electric Co.
Newton Rubber Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.
White, S. S. Dental Mfg. Co.

Bells.
Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S.
Metropolitan Electric Co.
Ostrander & Co.. W. R.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Belting.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Ball Engine Co.
Clonbrock Stm. Boiler Wks.
Freeman & Sons Mfg. Co.
Link Belt Machinery Co.
Weston Engine Co.

Books. Electrical.
Electrician Publishing Co.

Brass Goods.
Lunkenheimer Co., The.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Cables (See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Brixey, W. R.
Carter & Co.. Geo. G.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Cutter, Geo.
Eastern Electric Cable Co.
General Electric Co.
Great Western Mfg. Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Standard Underg. Cable Co.
Taylor, Dee & Mack.
Western Electric Co.

Carbons, Points & Plates.
Central Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co
Western Electric Co.

Car-Heaters, Electric.
Consolidated Car-Heating Co.

Clutches, Friction.
Falls Rivet & Machine Co.
Lake, J. H. & D. Co.
Link Belt Machinery Co.

Construction & Repairs.
Adams, W. L. & Co.
Allen-Hussey Co.
Amstutz, N. S.
Andrews & Haschke.
C. & C. Electric Co.
Capitol Model & Mach. Wks
Comstock, Louis K.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co
Mather Electric Co.
Osburn, Harry G.
Pullman Electric Co.
Stone, O. M.
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Contractors and Electric Light Plants.
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
C. & C. Electric Co.
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Clark Electric Co.
Colburn Electric Mfg. Co.
Complete Elec. Const. Co.
Comstock, Louis K.
Fort Wayne Electric Co.
General Electric Co.
Great Western Mfg. Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co
Mather Electric Co.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Siemens & Halske Elec. Co.
Stone. O. M.
United Elec Improvement Co
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Westinghouse Elec & Mfg. Co.
Western Electric Co.

Copper.
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Miamisburg Electric Co.

Copper Wires.
Adams. W. L. & Co.
American Electrical Works.
Bernard Co., The E. G.
Bishop Gutta Percha Co.
Brixey, W. R.
Bunnell & Co , J. H.
Carter & Co.. Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Iona Mfg. Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co.. The.
Phillips Insulated Wire Co.
Standard Underg. Cable Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Cross-Arms, Pins and Brackets.
Adams. W. L. & Co.
Anderson, Albert & J. M.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
McLeod. Ward & Co.
Taylor, Dee & Mack.

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Adams, W. L. & Co.
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Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Cutter, Geo.
Electric Appliance Co.
Electric Selector & Signal Co.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Iona Mfg. Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Melzer & Co.
Metropolitan Electric Co.
Perkins Elec. Switch Mfg. Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Washington Electric Co.
Western Elec. Supply Co.

Desk Lights.
McLeod. Ward & Co.

Dynamos.
Brush Electric Co.
C. & C. Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Fort Wayne Electric Co.
General Electric Co.
Great Western Mfg. Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
McMillan, Hugh.
Rose Elec. Light Supply Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
United Elec Improvement Co
Waddell-Entz Company.
Western Electric Co.
Westinghouse Elec. & Mfg.Co.

Electric Railways.
Brush Electric Co
Complete Elec. Const. Co.
General Electric Co.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

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Allen-Hussey Co.
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Complete Elec. Const. Co.
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Electrical Instruments.
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Central Electric Co.
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Phœnix Glass Co.

Electro-Plating Mach'y.
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Ball Engine Co.
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Freeman Sons Mfg. Co.
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Fan Outfits.
Diehl & Co.

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Standard Paint Co.
Vulcanized Fibre Co.

Fire Alarms.
Western Electric Co.

Fuel Economizers.
Fuel Economizer Co.

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Independent Electric Co.

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McMillan, Hugh.
Queen & Co., Incorp.
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Taylor, Dee & Mack.
Western Elec. Supply Co.

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Buckeye Electric Co.
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Westinghouse El. & Mfg. Co.

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Phosphor Bronze Sm. Co., Ltd.

Platinum.
Baker & Co.

Porcelain.
Empire China Works.

Publishers, Electrical.
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Push Buttons.
Central Electric Co.
Electric Appliance Co
Metropolitan Electric Co

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General Electric Co.
Washington Electric Co.

Sal Ammoniac.
Innis & Co.
Klipstein, A.
Law Battery Co.

Second-Hand Electrical Machinery.
Gregory, Chas. E. Co.
Rose Elec. Lt. Supply Co.

Silk Braid.
Boston Braid Mfg. Co.

Slate.
Independent Electric Co.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co. Incorp.
Whitney Elec. Instrument Co

Steam Heating.
Webster & Co., Warren.

Steam Piping.
Am. District Steam Co.

Steam Pumps.
Worthington, Henry R.

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Accumulator-Co., The
Bradbury-Stone Elec. S. Co.
Day-Moberg Elec. Co.
Elec-Power Storage Co.
Electric Storage Battery Co.

Stoves, Electric.
Consolidated Car-Heating Co.

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Brill, J. G. Co.

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American Electrical Works.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.

Telegraph Apparatus.
Central Electric Co.
Electric Appliance Co.
Electric Selector & Signal Co.
Greely & Co., The E. S
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

Telephones,
D'Unger Elec. Tel. Mfg. Co.
Hubbard & Co., Wm.
Lasell & Co., Edw.
Manhattan Elec. Sup. Co.
Western Electric Co.
Western Tel. Const. Co.

Transformers.
Hornberger Elec. Mfg. Co.
Stanley Electric Mfg. Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Tracks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Tools.
Lunkenheimer Co., The.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stilwell & Bierce Mfg. Co.

Universities.
Correspondence School of Technology.
Institute of Technology.

Valves.
Lunkenheimer Co., The.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.
Smith, S. Morgan.

Wire, Bare.
Anderson, Albert & J. M.
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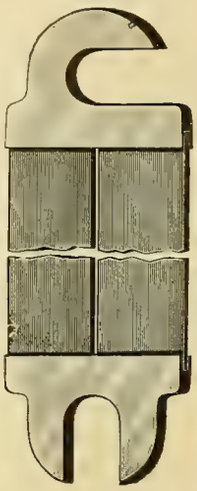
Crescent Ins. Wire & Cable Co
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co
National India Rubber Co
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons' Co.

ELECTRICAL SUPPLIES,

ELECTRIC FIXTURES,

COMBINATION FIXTURES



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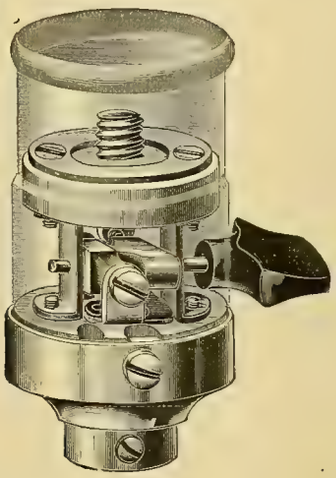

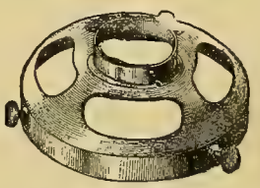

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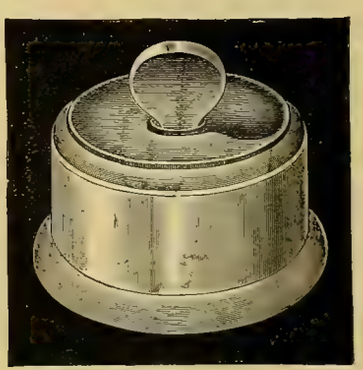

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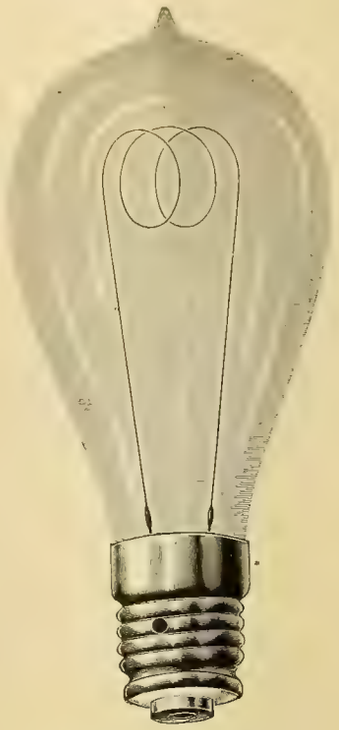
TWO LETTERS.

Extract from Letter No. 1.

"No! I've made up my mind to test the ***cheap lamp*** racket. The 'Buckeye' is all right, the best lamp ever placed on our circuit, ***but***—I am offered a lamp with individual life guaranty of 600 hours, two cents for bases returned; making the net ***first*** cost about ***five cents*** less than your quotation; so—frankly, I'm like the boy, who, in his customary manner upon going to bed kissed his mamma good night, but on this particular night did not say his prayer as usual, but hustled into bed, chucked the covers close up about his chin and ears, and closed his eyes preparatory to sleep. 'Willie, dear, said his mamma, haven't you forgotten something?' 'Nope,' answered Willie; 'Why—you haven't said your prayer!' 'I know it,' said Willie. 'Ain't a going to say 'em to-night, or to-morrow night, an if I ***get along*** all right ain't going to say 'em ***any more.'*** Now if I can ***get along all right*** with the ***cheap lamps,*** of course I shall be compelled to use them in the future."



Extract from Letter No. 2.

"Well, I've tried 'em—the ***cheap lamps*** I mean—and here I am back again 'Prodigal Son' like; somewhat the worse for wear and tear of nerves incident to the ***care*** required by my ***late investment;*** I found the lamps faulty in every way, the bulbs full of sand blisters, the filaments ***spotted,*** evidently improperly treated, and the way they broke, and sagged to ***side of bulb*** when placed at an angle was a ***caution.*** The bases were poorly fastened and I think in order to make a ***cheap*** lamp the manufacturer actually ***skimped*** in the ***quantity of water*** needed to properly mix the plaster of paris. The first few returned on account of not having burned more than 50 to 75 hours, were replaced, but when it became evident that quite one-half would fail on their guaranty, the party who sold me the lamps declined to replace them. Of course my customers became dissatisfied, but I have quieted them by saying that 'Buckeye' lamps have been ordered and are on the way.

"Haven't heard how that boy ***got along*** without saying his prayers; one thing sure: I ***won't*** get along without 'Buckeye" lamps.'

NO INJUNCTION,
NO BOND
HANGING OVER

THE BUCKEYE LAMP.

SUMMARY.

RESULTS are what you want, friends, not pretense nor subterfuge. Honest goods require only honest statements to find their market. ***Quality*** produces the ***result.***

If you write us for information regarding the "Bu keye" lamp you'll get the ***truth*** without ***sliding panels or false bottoms.***

If you want a { **3 Watt Lamp,** / **3 2-10 Watt Lamp,** / **3 1-2 Watt Lamp,** / **4 Watt Lamp,** / **or any other efficiency** } **we can furnish it.**

You undoubtedly place your orders where you ***anticipate*** the best value for your money. The ***coiled*** filament with its beautiful illuminating effect;

THE LOW OPERATING COST,
THE LONG LIFE AND
THE PURE WHITE LIGHT

All combined in the "Buckeye" Lamp, is a guaranty against failure or disappointment.

We are making prompt deliveries from our factory, and CHICAGO stock.

The Buckeye Electric Company,

CHICAGO, 753 Monadnock. **FACTORY, Cleveland, Ohio.**

W. W. GIBBS, President. HERBERT LLOYD, F. C. S., General Manager.

THE ELECTRIC STORAGE BATTERY CO.,

SOLE MANUFACTURERS OF

The Chloride Accumulator.

DREXEL BUILDING, PHILADELPHIA, March 2, 1894.

The Electric Storage Battery Company of Philadelphia on account of the misleading, unreliable and mistaken statements made by the manufacturers of the various storage batteries, in order to obtain for the public reliable information as to the relative merits of such batteries manufactured in this country, proposes to place in the hands of the eminent firm of Electrical Experts, MESSRS. HOUSTON & KENNELLY, OF BETZ BUILDING, PHILADELPHIA, a Chloride Accumulator of any given weight, to be tested by them against batteries of like weight of any or all other types manufactured in this country, whose makers are willing to submit to such competitive tests, with the understanding that there shall be deposited with such firm of experts by each party who enters into competition the sum of five hundred dollars. The Electric Storage Battery Company agrees to deposit a like sum against each competitor, with the understanding that in every case where the Chloride Accumulator does not prove to be at least fifty per cent. better, efficiency, capacity and durability (the essential features) being all considered, said deposits of one thousand dollars to be paid to each winning competitor, and in each case where the Chloride Accumulator proves in said tests to be fifty per cent. better, all three above essential features being considered, the one thousand dollars so deposited shall be awarded to The Electric Storage Battery Company; each party participating in said competition to contribute his proportion of the expenses incident thereto.

In order that the tests may be of the greatest practical value, The Electric Storage Battery Company suggests that a small cell suitable for traction, or other purposes, weighing about fifty pounds, and a larger cell, suitable for central station work, weighing from five hundred to a thousand pounds, be entered, although said company will meet the weight of any element that may be entered.

All parties desirous of entering these competitive tests will please communicate directly with Messrs. Houston & Kennelly, Electrical Experts, 1107 Betz Building, Philadelphia.

This challenge shall remain open for ninety days from March 1, 1894.

Messrs. Houston & Kennelly have agreed to undertake such competitive tests on the conditions contained in their letter which follows.

THE ELECTRIC STORAGE BATTERY COMPANY.

Office of HOUSTON & KENNELLY,

1107 BETZ BUILDING, PHILADELPHIA,
March 2, 1894.

THE ELECTRIC STORAGE BATTERY COMPANY,

DREXEL BUILDING, PHILADELPHIA.

GENTLEMEN:—We agree to make the above tests on the following conditions:

1. All results to be published.
2. Each contestant to be permitted to have one representative present at the firm's laboratory during the tests.
3. Each contestant to be permitted through his representative to withdraw his battery at any time, but in all such cases the tests will be published up to the point of withdrawal, and the deposit will be forfeited to the opponent.
4. No tests will be commenced until after the battery has been discharged one hundred times at a rate of three-quarters of an ampere per pound of electrode as shipped.
5. The tests to be of three kinds, namely: efficiency tests, capacity tests and durability tests.
6. The efficiency to be the ratio of output to intake, and to be measured in watt hours for energy capacity, and in ampere hours for current storage capacity. The battery to be considered as discharged when the E. M. F. per cell, on opening the circuit, falls below 1.75 volts. The criterion of full charge to be agreed upon in writing before the tests commence in each case.
7. The current capacity to be determined in ampere hours output from the point of full charge to E. M. F. of 1.75 volts as above, and to be rated in capacity per pound weight of charged cell, and per pound weight of dry electrodes as shipped.
8. The above tests to be made at varying rates of discharge per pound weight of dry electrodes as shipped, in order to determine the range of efficiency and capacity at varying outputs. In deciding the relative merits of two competing cells whose efficiency or capacity may be equal at different rates of discharge, the award will be given to the cell possessing the greater efficiency at the higher rate of discharge per pound of plate weight as above.
9. The durability tests to be made on the completion of the preceding tests and to be under conditions no more severe than those required for traction work. The durability will be measured by determining the number of working hours of charging and discharging at the rate of two and one-half amperes per pound of dry electrodes as shipped, which will reduce the storage capacity of the battery in ampere hours to one-half of its first valuation at that output.
10. The award will be made on the basis of the sum of the percentages of the Chloride Accumulator over contesting batteries on the three claims of efficiency, capacity and durability. The mean efficiency or energy and current, and the capacity in ampere hours of battery and electrodes being selected as the relative competitive efficiency and capacity in each case.

The efficiency, capacity and durability of the contesting cell will then be divided into the corresponding efficiency, capacity and durability of the Chloride cell, and if the sum of the three quotients exceeds three and one-half, *i. e.* three hundred and fifty per cent. minus three hundred per cent., the decision will be given in favor of the Chloride cell, but not otherwise.

Very respectfully,

HOUSTON & KENNELLY.

THE **ROOT BOILER** (Improved Water-Tube)

FOR

ELECTRIC LIGHT

AND **POWER PLANTS**

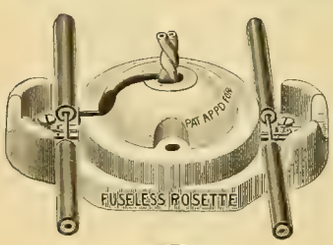
AND **STREET RAILWAY STATIONS.**

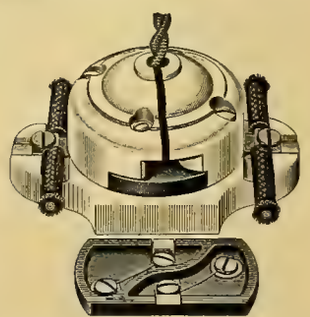
(The Root Improved Water-Tube Boiler.)

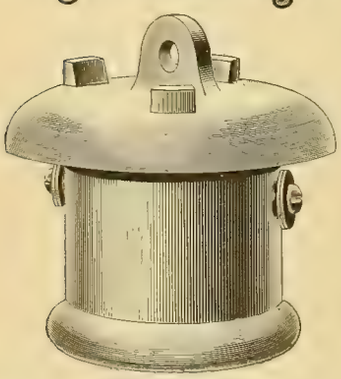
Absolute Safety with Highest Possible Economy.

ABENDROTH & ROOT MFG. CO.,

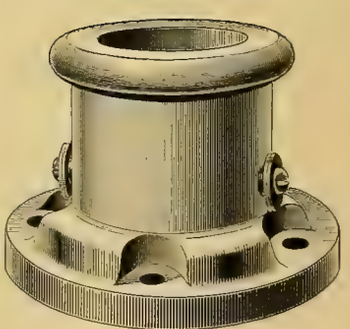
Catalogue? 28 CLIFF ST., NEW YORK.



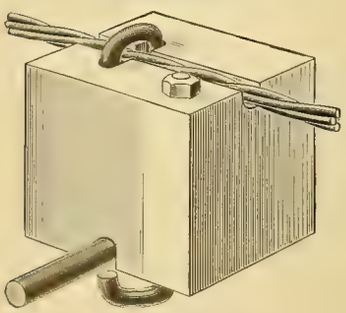


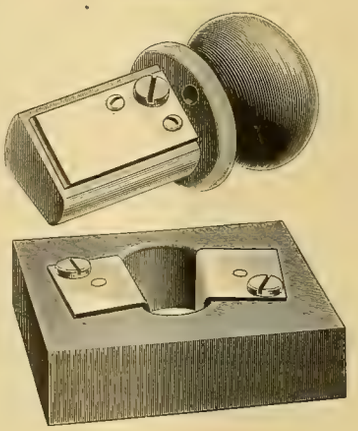


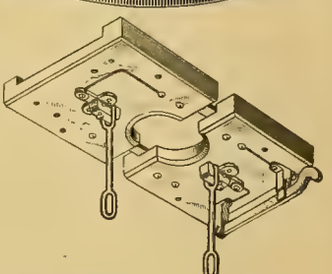
NEW SPECIALTIES



IN PORCELAIN.







HAMMOND CLEAT & INSULATOR CO.,

15 CUSTOM HOUSE ST., BOSTON, MASS.

STORAGE BATTERIES, FOR TROLLEY LINES,

— AND —

Central Lighting Stations,

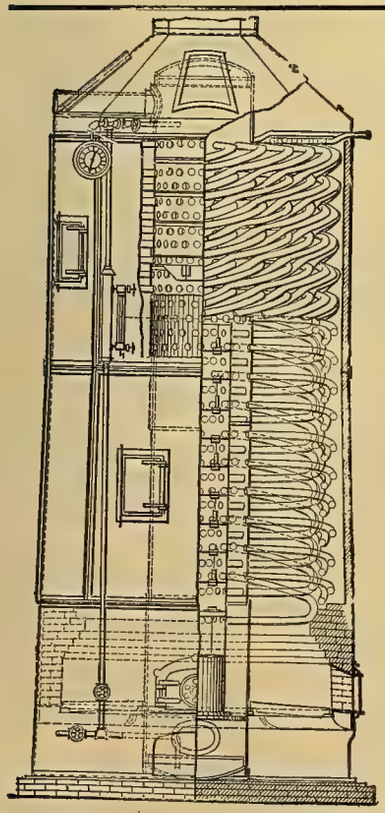
Properly Installed and Guaranteed,

REQUIRE	SECURE
Less Investment,	Greater Economy,
Less Power,	Constant Load,
Less Labor,	Constant Voltage.

[Our 30 H. P. cell (12,000 ampere hours) occupies one-half cubic yard.]

The Accumulator Company,

224 Chestnut Street, Philadelphia.



THE "MORRIN" CLIMAX STEAM GENERATOR

Has been acknowledged by all practical minds, the Best Boiler Invented.

A TESTIMONIAL.

FROM THE LABORATORY OF THOMAS A. EDISON.

ORANGE, N. J., February 6, 1894.

CLONBROCK STEAM BOILER WORKS, Brooklyn, N. Y.

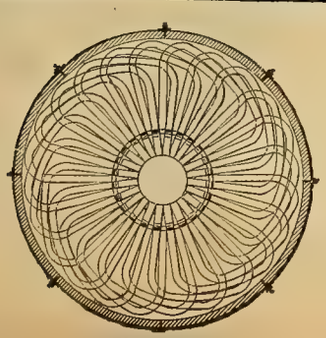
Dear Sirs:—Your letter of 30th ultimo is received. I have a Climax Boiler, and it is giving great satisfaction. Taking everything in consideration, it is, in my opinion, practically and theoretically, the best boiler so far invented. Yours truly,

THOS. A. EDISON.

A Partial List of Recent Installations.

The Westinghouse Electric Company,	Pittsburg.
The Brush Electric Co.,	Baltimore.
Chicago Arc-Light and Power Co.,	Chicago.
The Newark Electric Light and Power Co.,	Newark, N. J.
The Edison Electric Ill. Co.,	Brooklyn.
Essex County Electric Co.,	Orange, N. J.
New Britain Electric Co.,	New Britain, Conn.
Safety Electric Light Co.,	New York.
Thomson-Houston Electric Co.,	New York.
United Electric Light and Power Co,	New York.

These Boilers built in units from 50 to 1500 H. P.



MANUFACTURED BY

CLONBROCK STEAM BOILER WORKS,

Court Creamer, Lorraine and Smith Sts.,

Send for New Catalogue.

BROOKLYN, N. Y.

THE HOWARD SYSTEM.

"THE NEW INCANDESCENT ARC LIGHT."

PERFECT DISTRIBUTION OF LIGHT. FOR ALL CIRCUITS. COST OF TRIMMING REDUCED TO A MINIMUM.

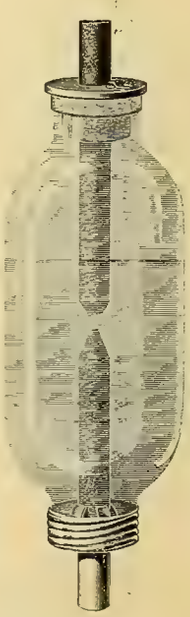
APPURTENANCES CAN BE ATTACHED TO ANY MAKE OF ARC LAMP.

"The importance to the future of the electric lighting industry cannot be over-estimated." *The Electrical Engineer, New York.*

"The most efficient spark arrester presented."
C. M. GODDARD, Sec.,
International Underwriters' Ass'n.

"The best spark arrester that can be devised."
F. E. CABOT, Supt.,
Boston Board of Fire Und.

"Unqualified approval as a spark arrester."
C. M. GODDARD,
Treas.,
N. E. Ins. Exchange.



"A complete fire protector and practical apparatus."
A. C. DUNHAM,
Pres.,
Hartford Elec. Lt. Co.

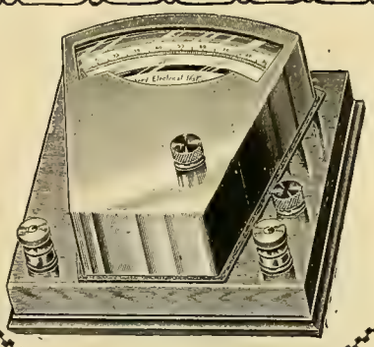
Life of one pair of 7/16 inch carbons over 100 hours.

This system has been introduced in the City of Hartford, Conn. by the Connecticut Royal Arc Co., and has been in continuous operation on street and commercial circuits for the past five months. Merchants in the City of Hartford employing Arc Lights by adopting this appurtenance have been able to save 33⅓ per cent. from established rates made by the Hartford Board of Fire Underwriters.

The commercial advantages enjoyed when this equipment is adopted are many: Cleanliness, removal of anxiety in regard to fire and the necessity for trimming the lamp reduced to twelve times per year, where average lamp hours are employed.

THE ROYAL ARC ELECTRIC CO., U. S. A. 143 Liberty St., New York.

WIRES AND CABLES.



WHITNEY INSTRUMENT.

WIRES AND CABLES.

THE REASON WHY

You should use a high grade wire on your lines is because you are reducing the loss by leakage, not only for a day or a week, but for the life of your circuit.

WHAT PROFITETH IT A MAN

If he save a whole cent a pound on his weatherproof wire and lose "his wad."

O. K. LINE WIRE GIVES THE RESULTS

AT THE BOTTOM PRICE.

It occupies the place among weatherproof wires that is held among rubber-covered wire by

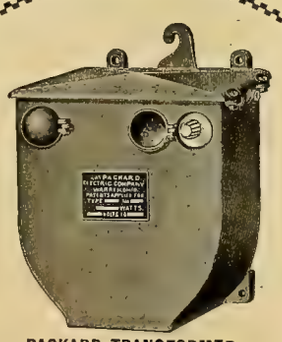
PARANITE--AT THE TOP.

ELECTRIC APPLIANCE COMPANY,

Electrical Supplies,

242 MADISON STREET, CHICAGO.

WE TRADE THEM EVEN FOR DOLLARS.



PACKARD TRANSFORMER.

The Great North Western Telegraph Co.
of Canada.

Office of
Treasurer & Superintendent of Supplies.

Toronto, Ont. Jan. 11th. 1894

4155.

W. R. Brixey Esq.
Manufacturer of Kerite
Insulated Wires & Cables
203 Broadway. New York. N. Y.

Dear Sir,

Replying to your enquiries.

I beg to state that it is now over two years since we ordered from your firm the 6000 feet of 18 Conductor Aerial Kerite Cable, for use in the Tunnel under the St. Clair River, between Sarnia Ont. and Port Huron Mich.

We have pleasure in stating that during the whole of this time, although the Cable has been continually subjected to the severe test of steam &c, it has given perfect satisfaction.

Yours truly,

Treasurer and
Sup't of Supplies.

Kerite Insulated Wires and Cables

Received the only award at the World's Fair for "High Insulation, Excellence of Material, Durability and Reliability under the Most Exacting Conditions." Over 300 miles of 8-conductor ***Kerite*** Aerial Cable constructed for and now in use on the New York Central and Hudson River Railroad Co. ***The Longest Length of this class of Cable ever put in use.***

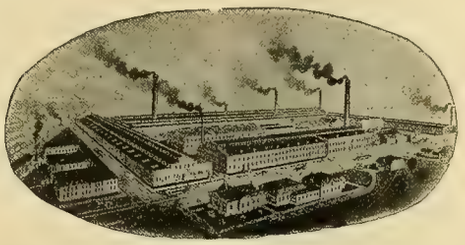
W. R. BRIXEY, Manufacturer,

J. E. HAM, GENERAL AGENT, **203 BROADWAY, NEW YORK.**

CALIFORNIA: CALIFORNIA ELEC. WORKS, San Francisco.
NEW ORLEANS: NEW ORLEANS ELEC. CO.
CHICAGO: CUSHING & MORSE, 225 Dearborn St.
CINCINNATI: CREAGHEAD ENGINEERING CO., 296 Plum St.

Electric Motors and Generators.

Incandescent Lighting Machines.

Arc  Lamps.

Arc Lighting Apparatus.

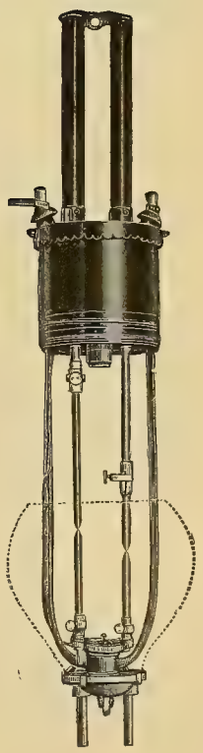
Alternating Current Apparatus.

THE BRUSH ELECTRIC COMPANY,

CLEVELAND, OHIO.

SOMETHING NEW.

An Arc Lamp without Spring, Wax, Glycerine or Mercury.



Send for Samples of the

New Brush Arc Lamp.

The Only Lamp for All Night Lighting.

THE C. & C. ELECTRIC COMPANY

Are Prepared to Furnish

MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

General Office:
143 Liberty Street, NEW YORK.

Works: GARWOOD, N. J.
on CENTRAL R. R. of N. J.

BRANCH OFFICES: CHICAGO, 201 Madison St., BOSTON, 63 Oliver St., CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

THE

BOTTOM HAS DROPPED OUT

OF PRICES

Just at present, but is likely to be found again soon, so if you want anything,

NOW IS THE TIME TO BUY!

Ask for quotations on

Railway Generators, Motors, Station Appliances, Line Supplies, Rail Bonds, Etc.

Incandescent Generators and Lighting Supplies.

Stationary Motors, (Constant Potential).

House Goods, including Annunciators, Batteries, Burglar Alarms, Bells, Pushes, Etc.

Telephone Magnetos and Supplies.

Magnet Wire, No. 3 to 36, B. & S. Cotton and Silk Covered.

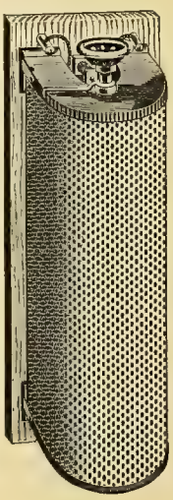
HUGH McMILLAN,

1427 Woodward Avenue,

DETROIT, - MICHIGAN.

MEISSNER'S IMPERIAL

Rheostat and Stage Dimmer.

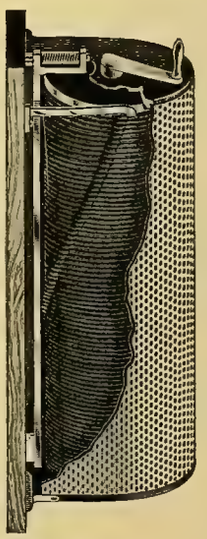


Contact made on wires direct instead of on segment face.

Changes from light to dark and vice versa, made perfectly even and gradual.

Finest scenic effects produced without difficulty.

INCOMBUSTIBLE,
DURABLE,
COMPACT and
REASONABLE IN PRICE.



Meissner's Improved Theatrical Focusing Lamp—best in the world.

Meissner's Focusing Lamp for photo-engraving and stereoscopic work has no equal.

For particulars apply to

WASHINGTON ELECTRIC CO.,

197 and 199 S. Canal St., Chicago.

Arc Globes and Incandescent Shades.

We make a Specialty of these goods, and can always make prompt shipments.

JAMES J. MURRAY & CO.,

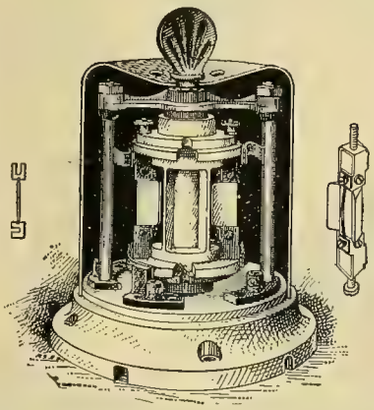
MURRAY FLINT GLASS WORKS,

TRENTON AVE., CULVERT and WATERLOO STS., PHILADELPHIA, PA.

BURNED OUT

Fuses are hard to replace in ordinary branch blocks, but EASILY accomplished with a MULTIPLE FUSESWITCH.

NEAT,
SAFE,
RELIABLE.



QUICK, SIMPLE, DURABLE.

PORCELAIN Base, Fuse Drum, REMOVABLE Fuse Holders and an Opal "Lead" Glass Ventilated Cover. DOUBLE OR SINGLE POLE. Copper Tipped Fuses.

A quarter turn produces a new fuse.

MELZER & CO., 310 Seneca St., Cleveland, Ohio.

ELECTRIC TELEPHONES.

We are prepared to furnish first-class telephone receivers in quantities at very low prices.

Our complete outfit, including transmitter, receiver and signaling apparatus, will be ready for delivery after February 15th. These outfits will have an automatic circuit-changing device, which we guarantee is no infringement.

We are headquarters for telephone receiver shells, permanent bar magnets, magneto bells, line material, etc.

THE MESCO DRY BATTERY

is recommended for telephone transmitter and all other open circuit work. **Over 200,000 in use. PRICES REDUCED,** making it the cheapest reliable open circuit battery on earth.

GET OUR PRICES on Leclanche batteries, zincs, Manhattan door opener (no push-out spring required), watchman's clocks (just out). Special low prices on speaking tubes, whistles, bronze push buttons and annunciators. We have a **Job lot** of spun, bronze and nickel plated push buttons.

If you will send us your address we will get some of your trade.

Manhattan Electrical Supply Co.,

36 Cortlandt St., NEW YORK.

CHICAGO, Wabash Avenue and Lake Street.

We are the
General Western Agents
for the
VIADUCT MFG. CO.,
of BALTIMORE, MD.,
and have a full line of
COMPLETE TELEPHONES,
Telephone Switch Boards,
Magneto Bells with Patent Arm-rest Switch, Magneto Bells for Testing Purposes, District Messenger Boxes, etc., etc.

These goods have long been regarded as the **BEST.** Get our circulars and prices. Deliveries made from Chicago **STOCK.**

We are also the
Sole Manufacturers
of the popular
MONARCH **Incandescent LAMPS.**

The large and increasing **demand** for this lamp shows **better** than anything else the **good results** our patrons **secure** in their use, because they are well and **carefully** made, and our **prices** are low, too

Let us ship you a trial lot, which we **guarantee** as we represent.

All styles shipped **promptly.**

Edward Lasell & Co.,

225 Dearborn Street, - CHICAGO, ILL.

The "Ideal" Storage Battery

For all Classes of Work where Light and Power are Required.

NORTH AMERICAN PHONOGRAPH COMPANY.

CHICAGO, ILL., September 13, 1893.

MESSRS. BRADBURY-STONE STORAGE BATTERY CO., Lowell, Mass.

GENTLEMEN:—We take a great deal of pleasure in being able to laud the merits of the Bradbury-Stone Ideal Storage Battery for use in connection with the Phonograph. Within the last few months we have purchased in all several hundred of your cells, and have shipped them on orders to various parts of the country in almost every conceivable manner. They have withstood the most severe tests, and have in all cases given entire satisfaction.

Yours truly, THOS. R. LOMBARD, General Manager.

Thousands in use all over the country.

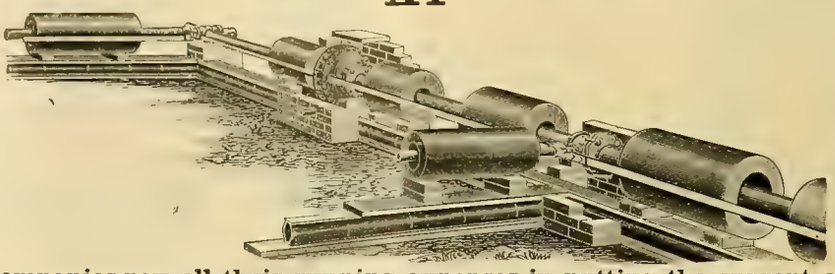
Bradbury-Stone Electric Storage Co.,

Boston Office, 542 Exchange Bldg. LOWELL, MASS.

Electricity Free of Cost

AT

Central Stations.



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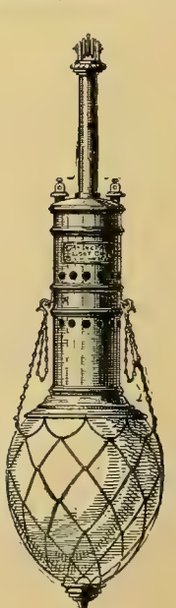

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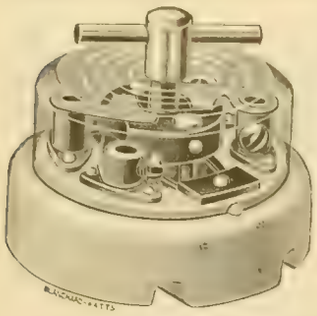

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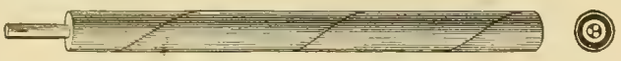

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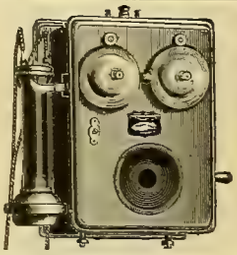

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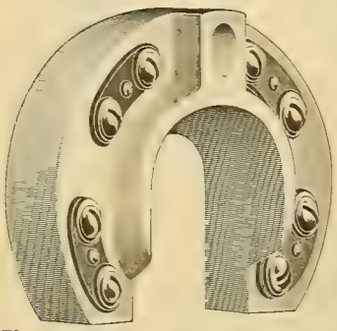

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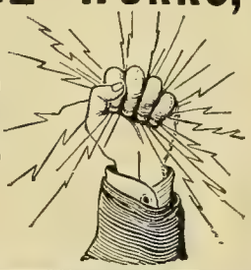

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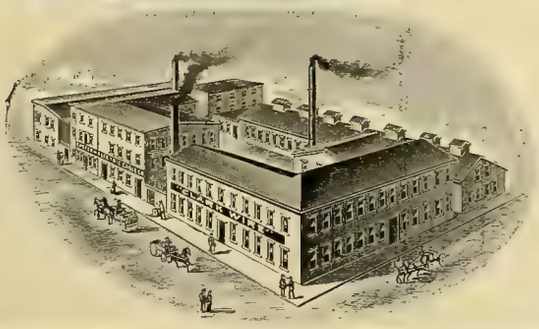

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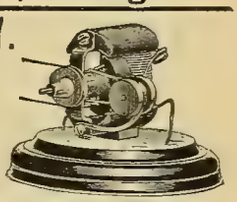

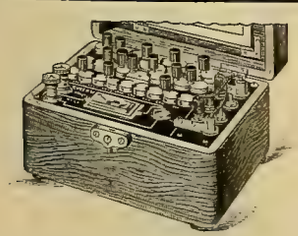

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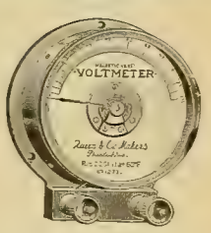

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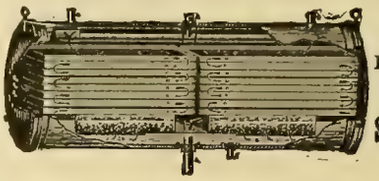

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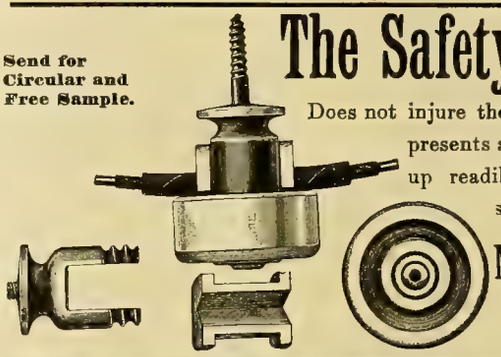

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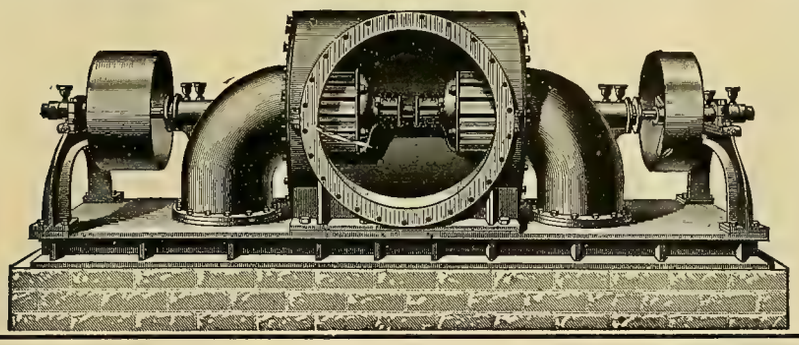

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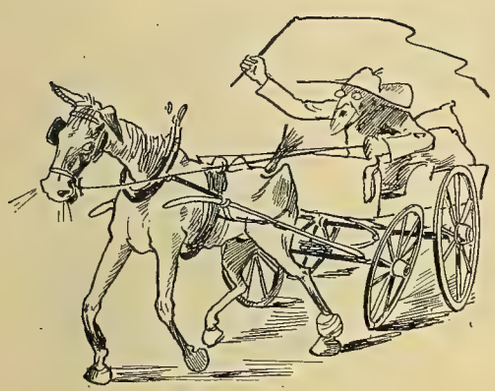

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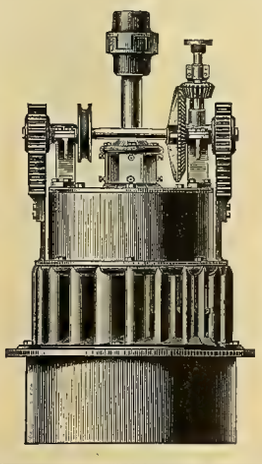

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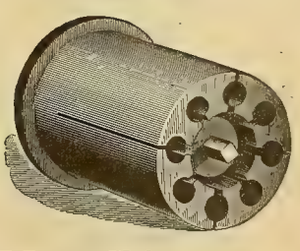

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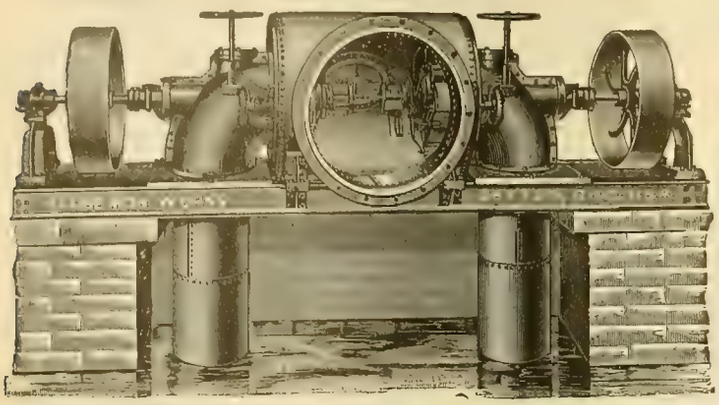

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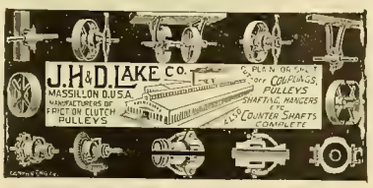

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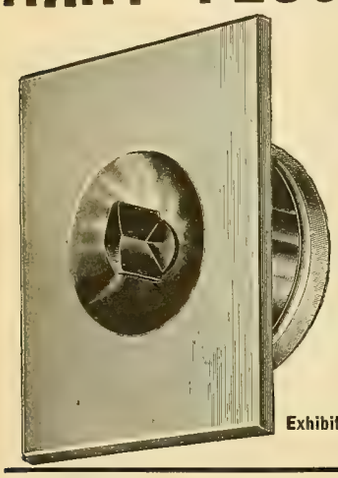

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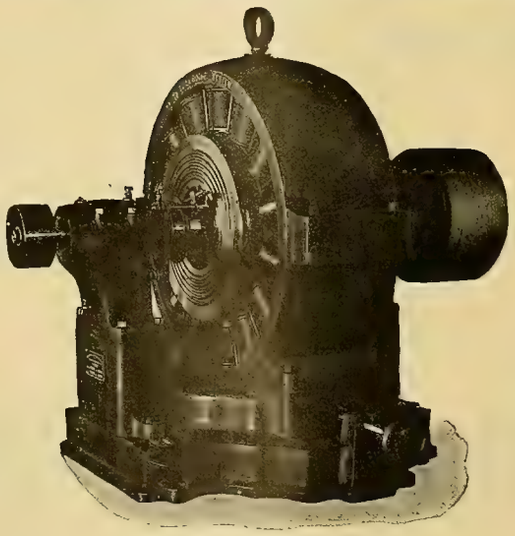

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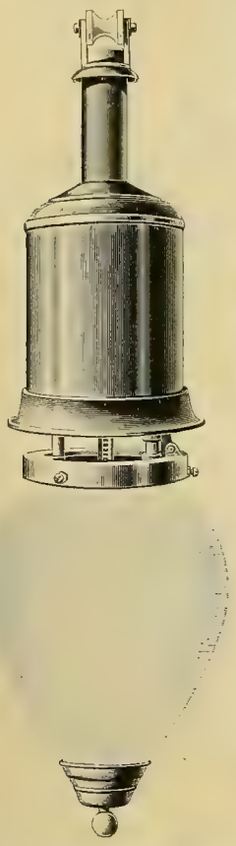

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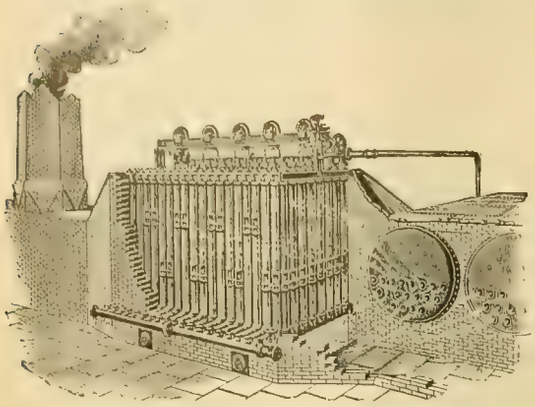

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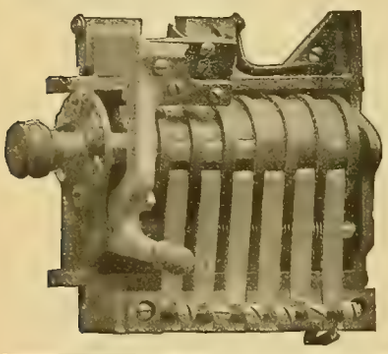

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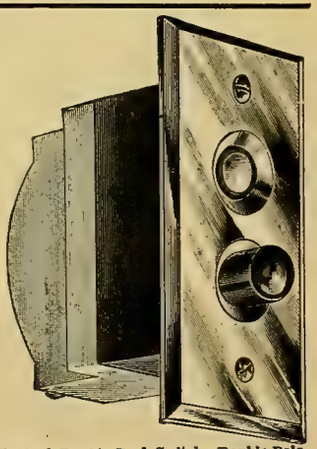

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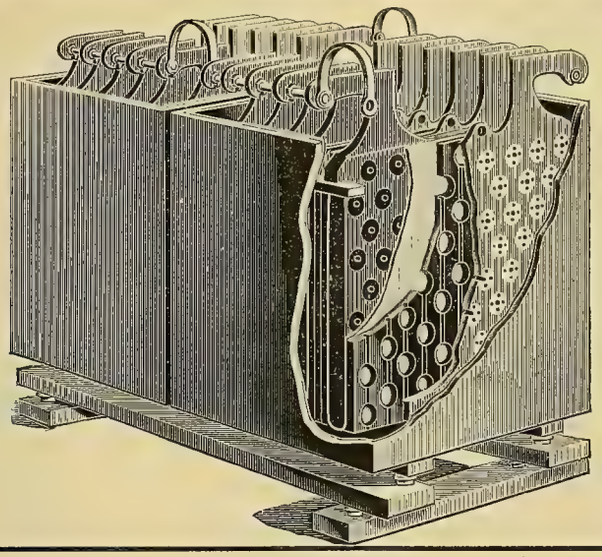

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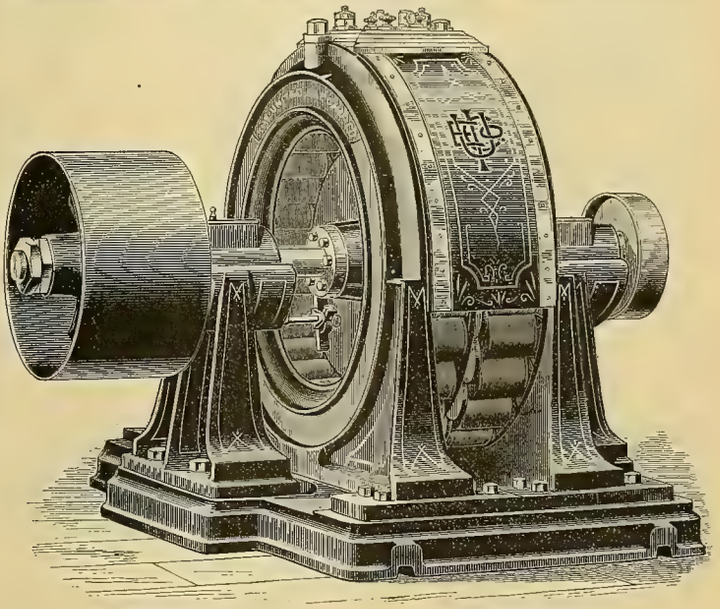

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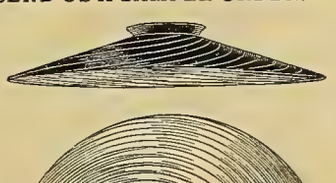

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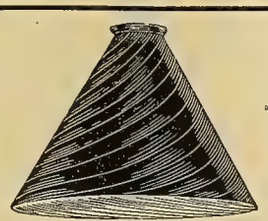

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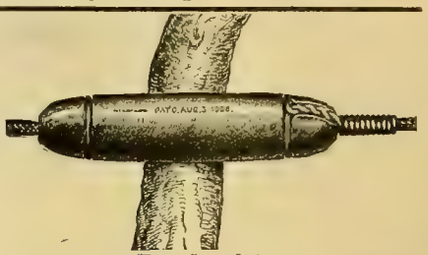

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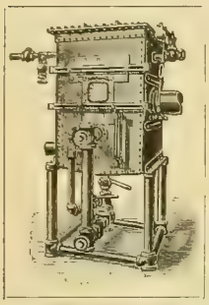

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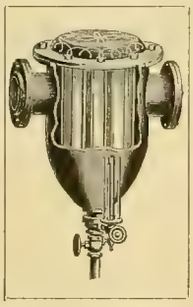

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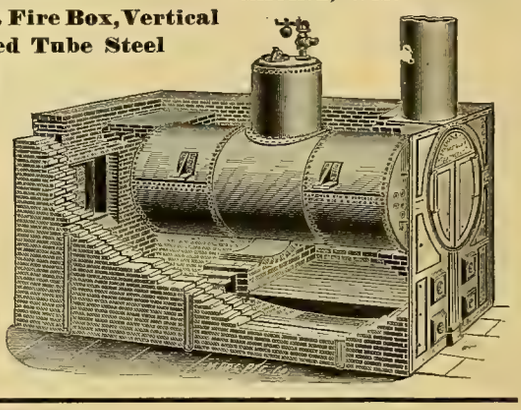

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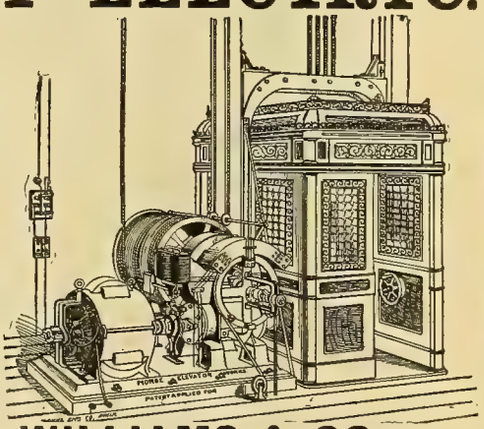

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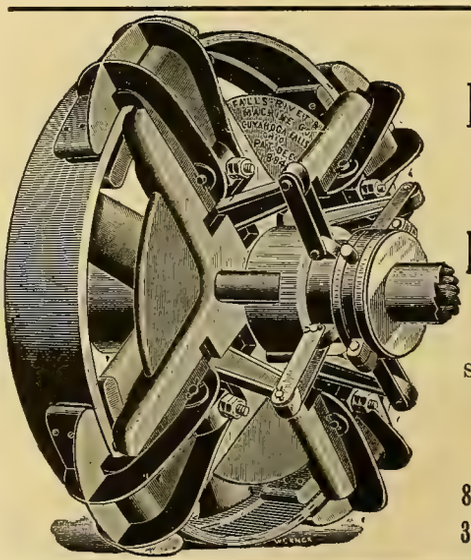

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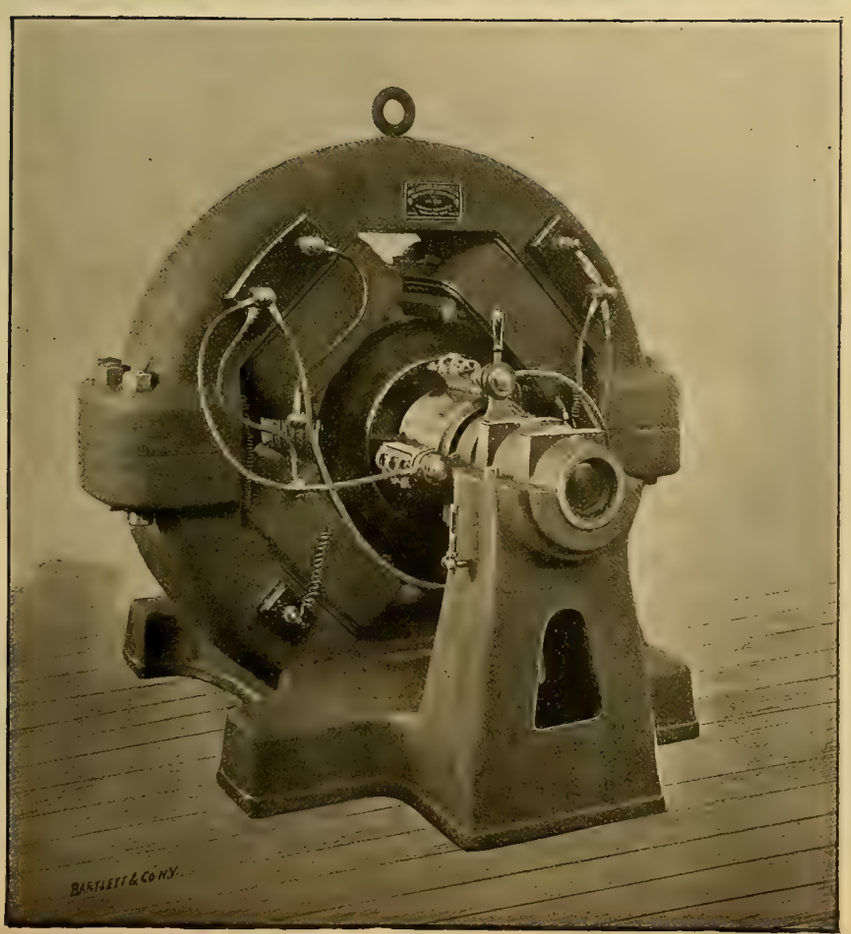

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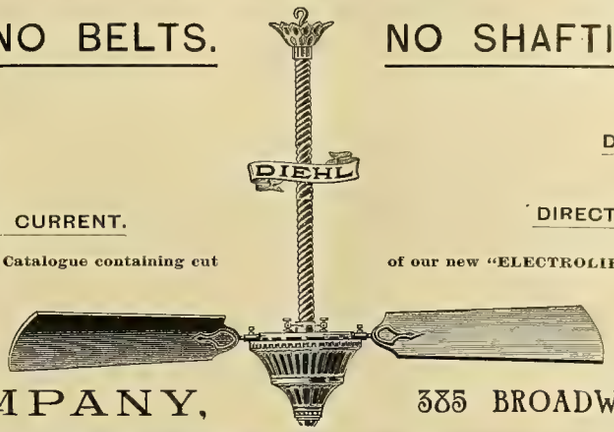

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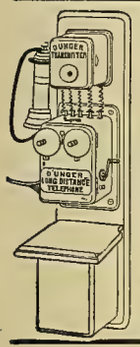

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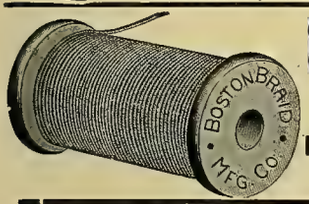

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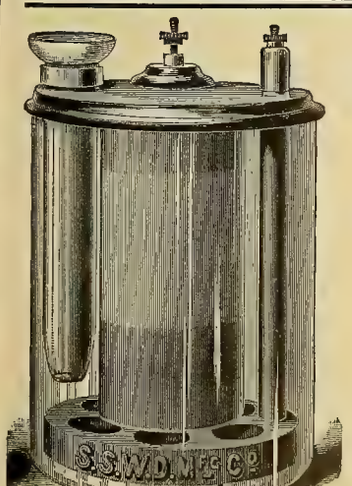

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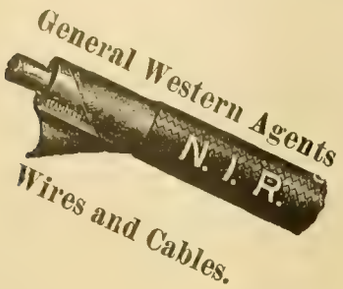

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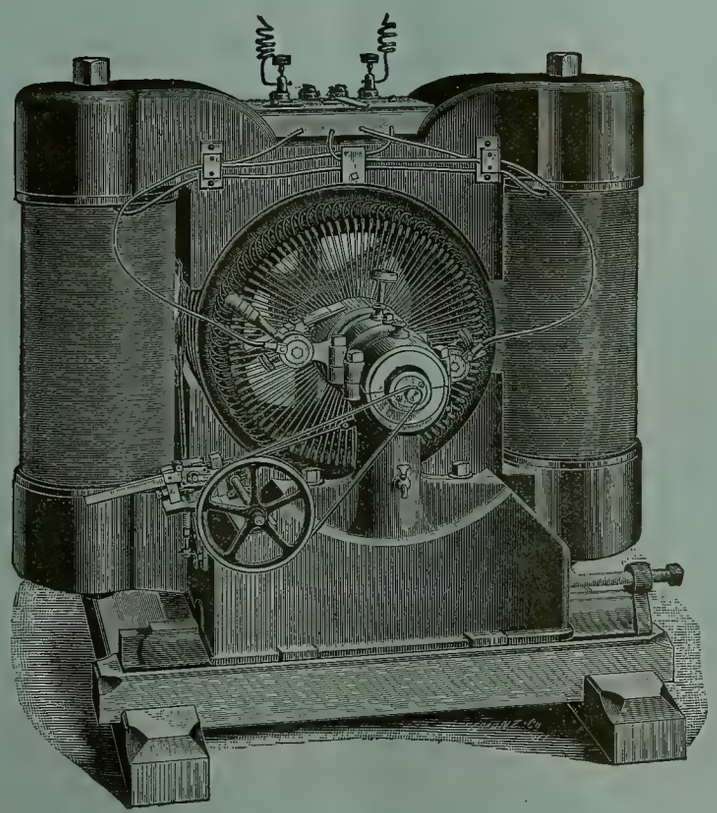

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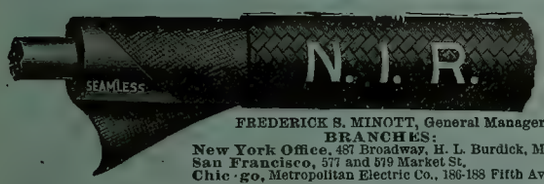

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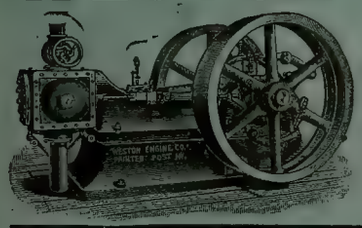

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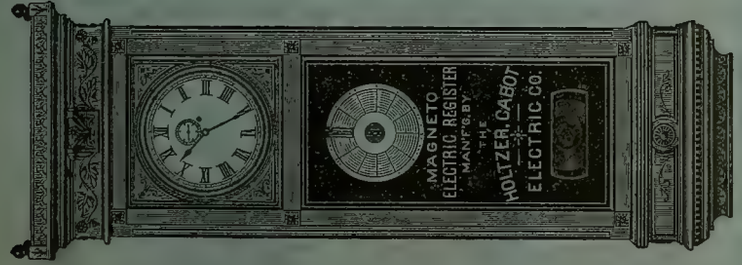

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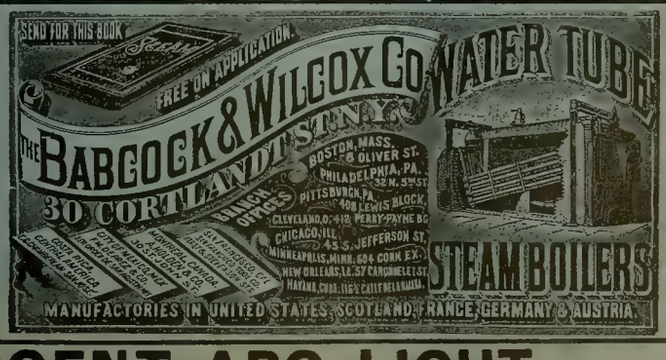

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Dow Adjustable Lt. Co.

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Arc Light Cord.
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Armature Winders.
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Cushing & Morse.
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Metropolitan Electric Co.
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Roebling's Sons Co., J. A.
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Western Electric Co.

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Taylor, Dee & Mack.
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Western Elec. Supply Co.

Cross-Arms, Pins and Brackets.
Adams, W. L. & Co.
Anderson, Albert & J. M.
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Taylor, Dee & Mack.

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Direct Driven or Belted, in sizes up to 250 H. P.

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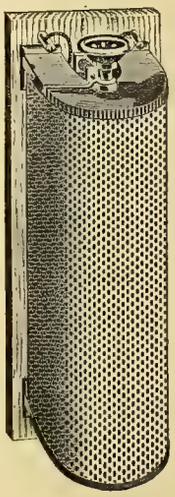

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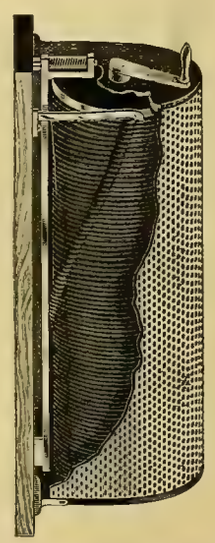

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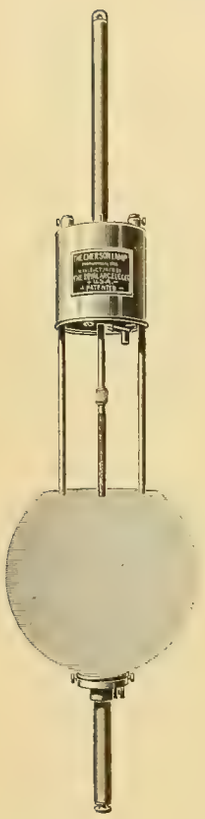

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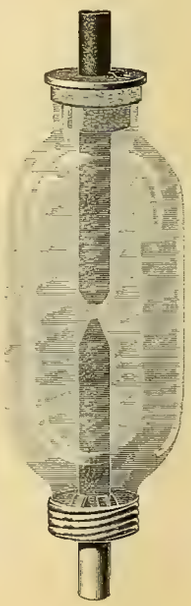

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Life of one pair of $\frac{7}{16}$ inch carbons over 100 hours.

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Central Lighting Stations,

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[Our 30 H. P. cell (12,000 ampere hours) occupies one-half cubic yard.]

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Electric Motors and Generators.

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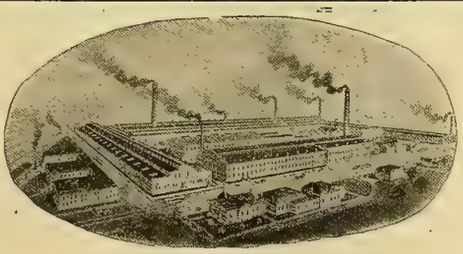

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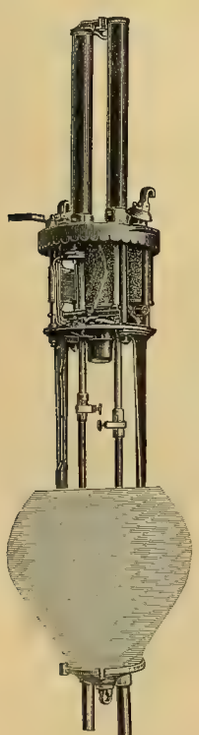

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An Arc Lamp without Spring, Wax, Glycerine or Mercury.

Send for Samples of the

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THE ONLY LAMP FOR ALL-NIGHT LIGHTING.

STORAGE BATTERIES!

OUR STORAGE BATTERIES
Contain no active material artificially applied.

WE ARE NOT COMPELLED
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BECAUSE WE DO NOT REQUIRE THESE ARTIFICIAL SUPPORTS FOR PREVENTING THE ACTIVE MATERIAL FROM FALLING OUT.
We do not claim great "capacity per pound weight," but

WE DO CLAIM TO HAVE A BATTERY COMBINING DURABILITY
And efficiency in a higher degree than any other Battery made in this country.

☞ We Guarantee This to Purchasers.

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At World's Columbian Exposition, Chicago, was given to us.

WE ARE READY TO SPEND MONEY DEMONSTRATING
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GOOD RESULTS IN ACTUAL SERVICE
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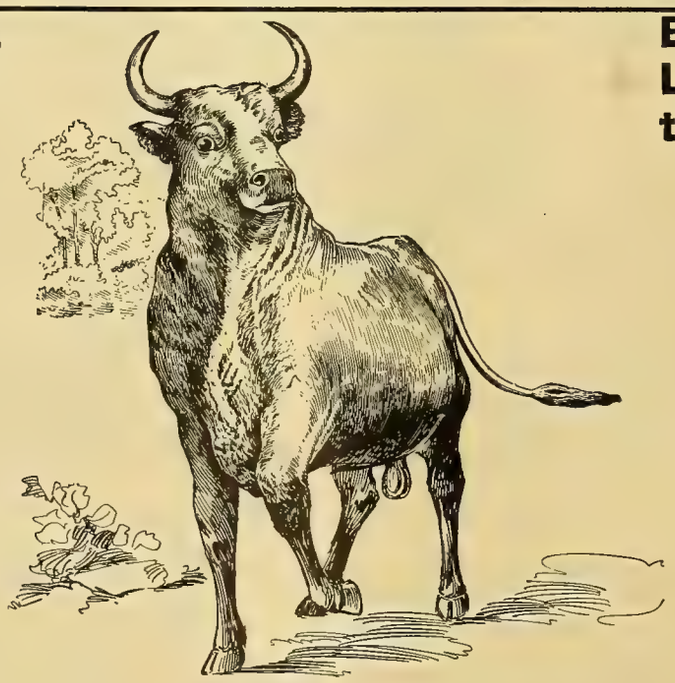
Send for new "Light and Power" Catalogue.

Don't make a Alternating Arc investigating



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Everything about it is of the very best. Brass Frame, Brass Shell, Brass Cap, Brass Rods. No tin or stovepipe iron. It combines unequaled simplicity with absence of all objectionable features heretofore present in alternating lamps. It is a **NON-STICKER** that central station men and lamp trimmers will be **STUCK** on because they don't have to **MONKEY** with it every few days, taking it down to clean and oil. Lamps for all systems. We guarantee every lamp. Write for prices.

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Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Out Last and Out Class any other on the Market.

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All styles shipped **promptly.**

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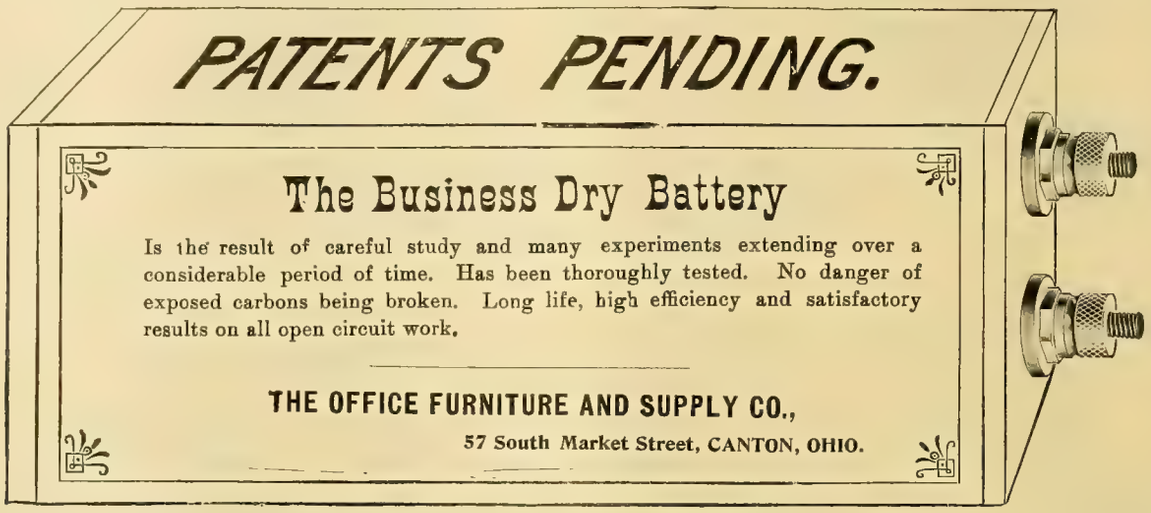

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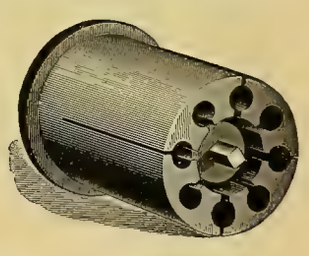

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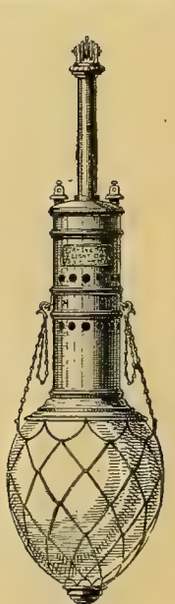

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The Wurtz Non-Arcing Lightning Arresters for Direct and Alternating Current Circuits, are the only Lightning Arresters which do not allow the dynamo current to follow the discharge, and which do not require automatic arc-rupturing attachments; no inspection and no attention, no arcs and no fire risks; no magnets to fail and no moving parts to stick; no interruption of the work circuit. Thousands in use and not a single failure. Adapted to all kinds of arc, incandescent, and power circuits.—Descriptive circular sent on application.

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Still, we undoubtedly get a large share of it, and make those who place all of their orders with us

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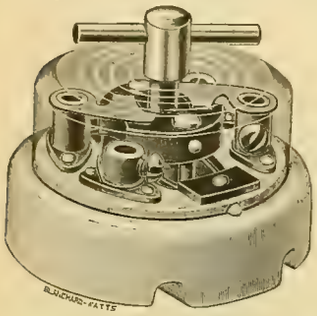

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But have your burned-out armature rewound by us with our

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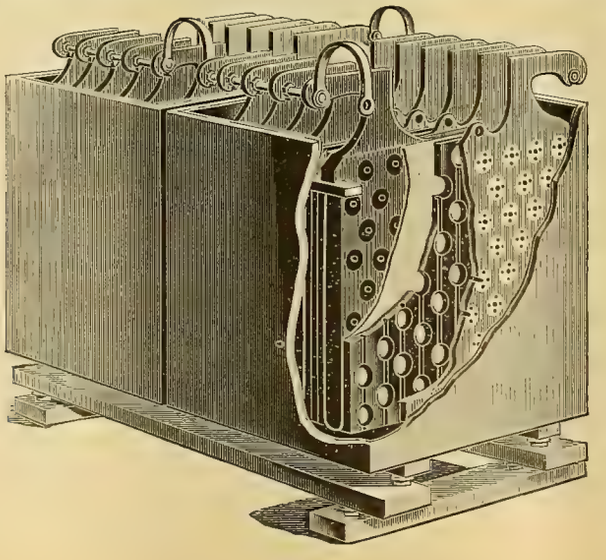

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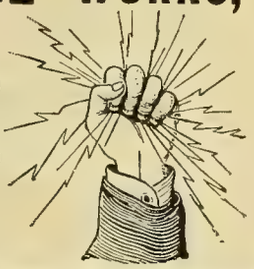

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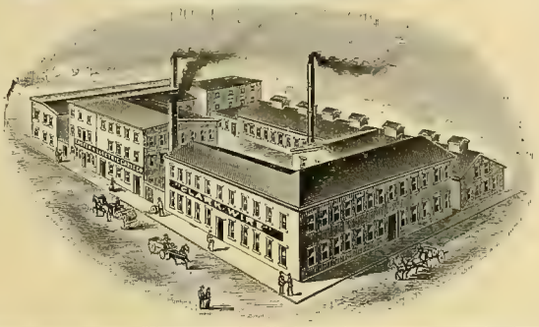

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We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

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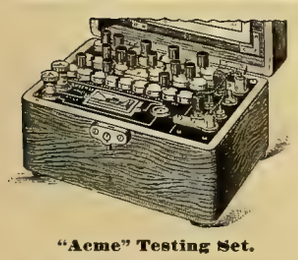

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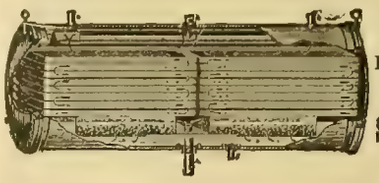

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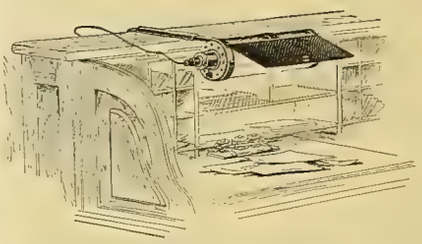

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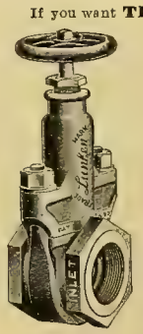

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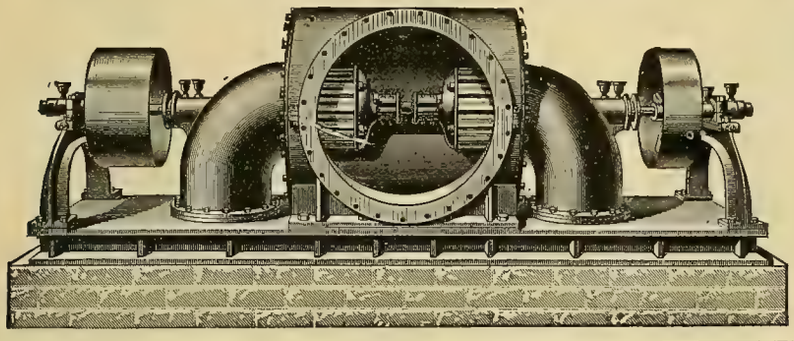
VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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The accompanying engraving represents a pair of 12 inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

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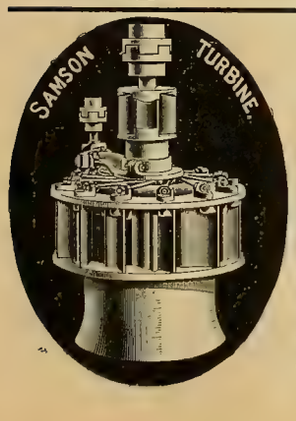

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It is SPECIALLY DESIGNED and ADAPTED for driving

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Our new Wheel secures a remarkably **high guaranteed percentage,** and **wonderful steadiness** of motion, under variable loads in practice. It affords an **unequaled concentration** of power within a small space; and an **unprecedented high velocity** for a given power.

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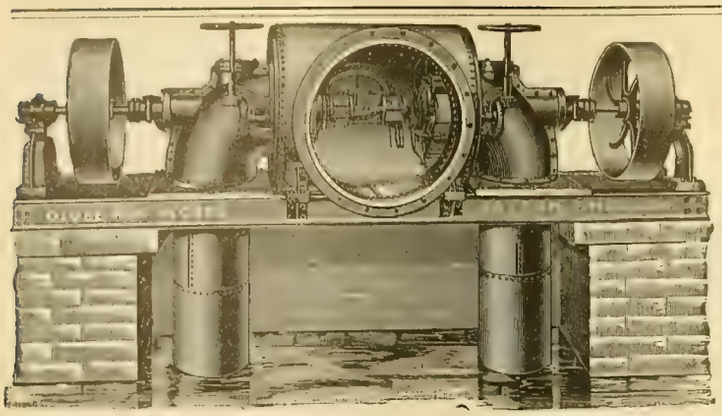

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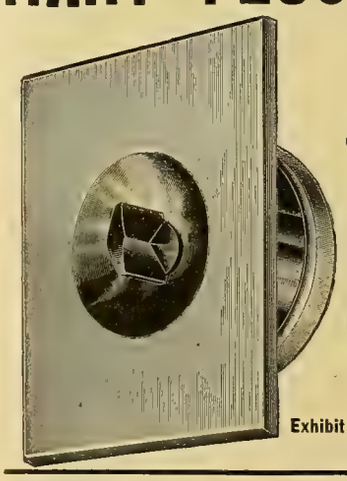

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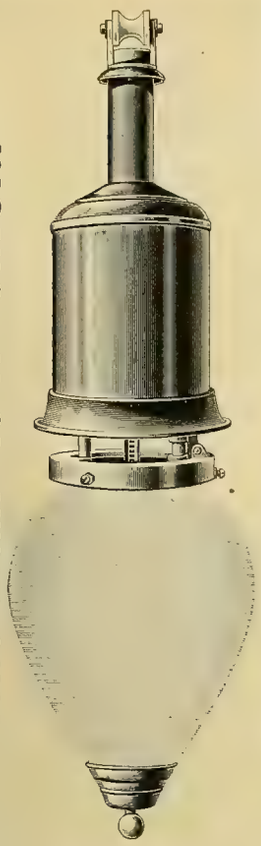

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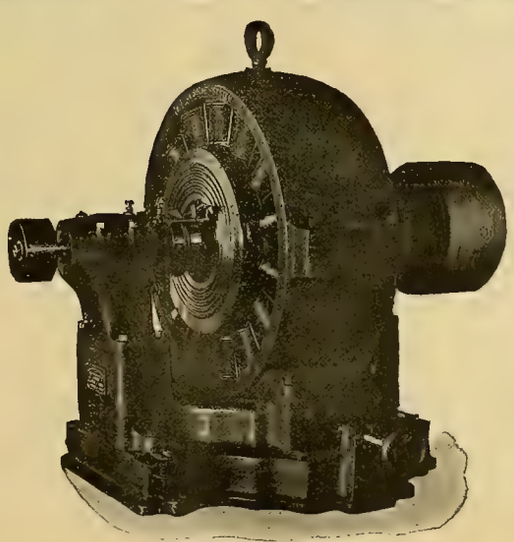

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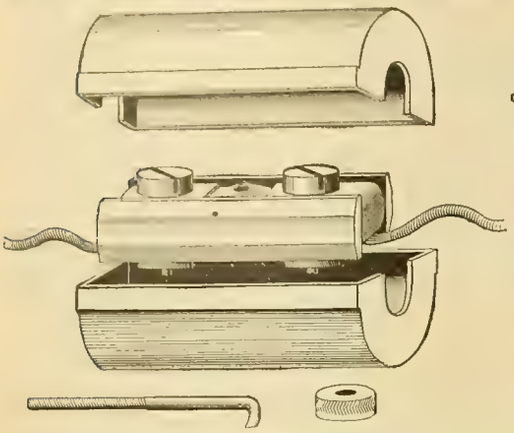
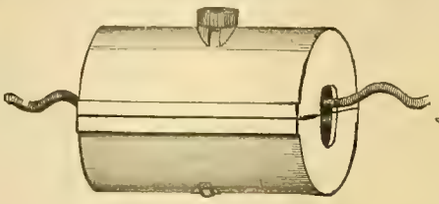


Enlarged cut showing construction of Gleason's Porcelain Lighting-Bug Cut-Out covered with porcelain.



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Price Each, Complete, 22½ cts. List.

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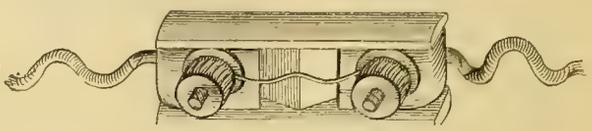

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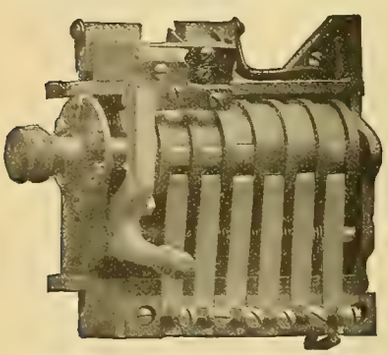

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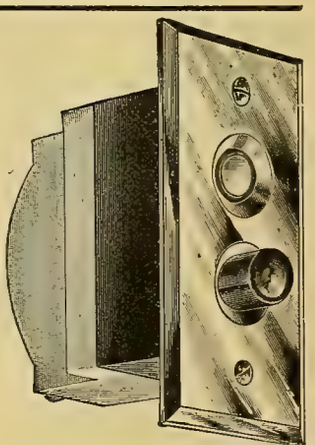

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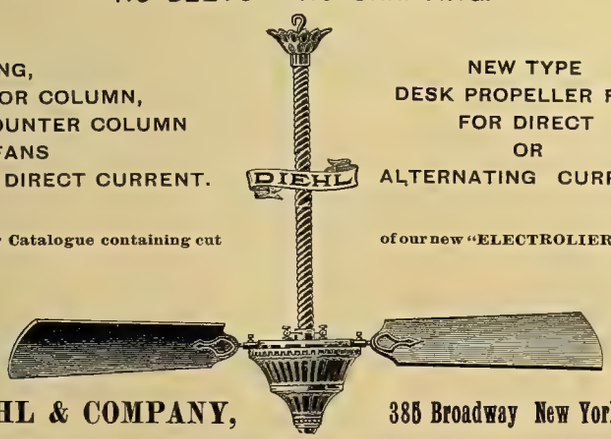

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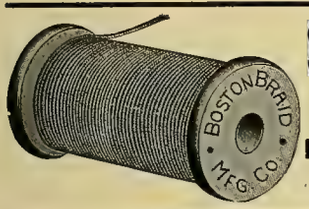

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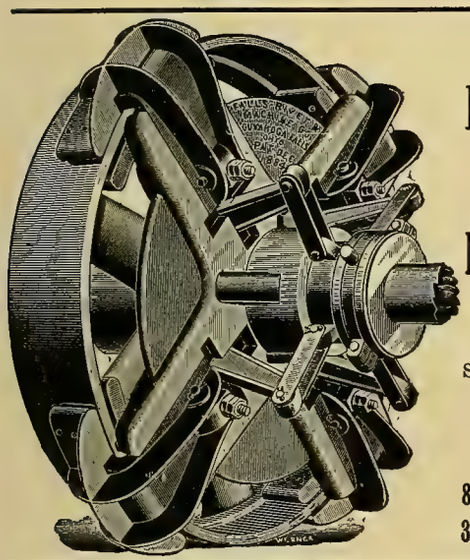

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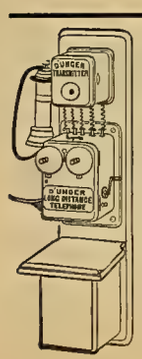

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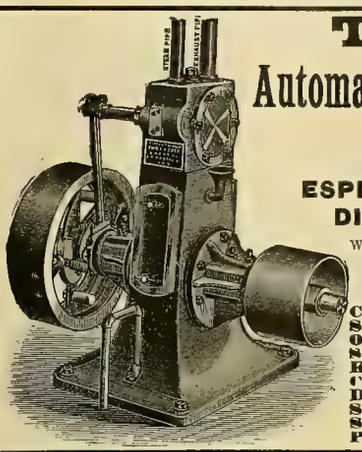

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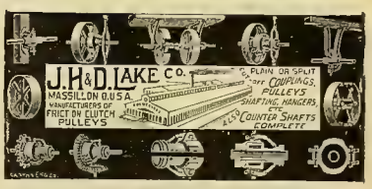

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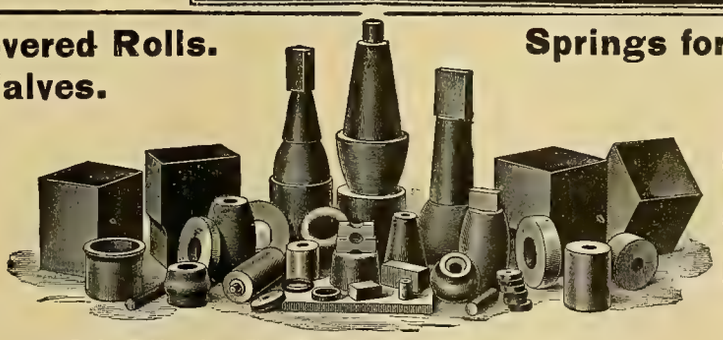

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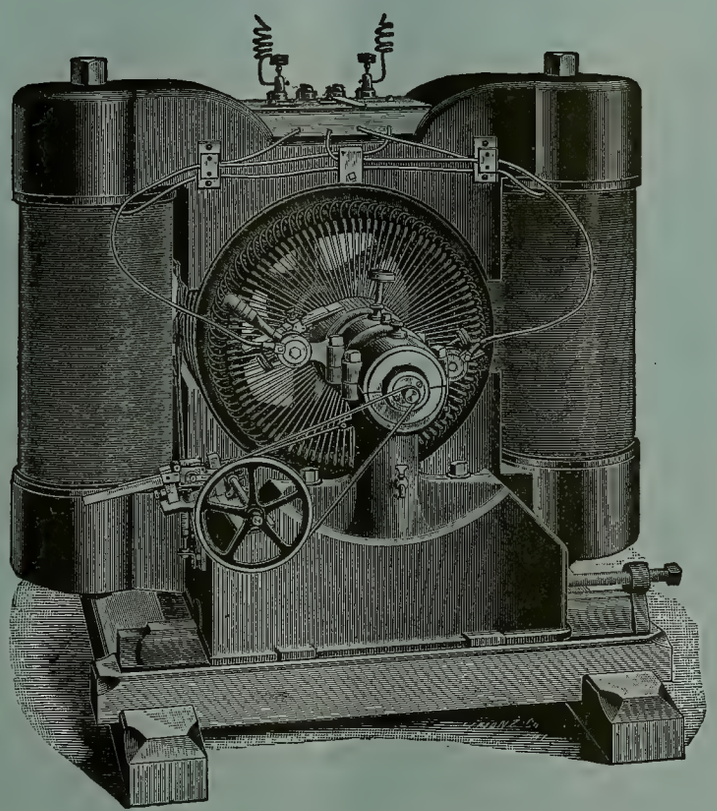

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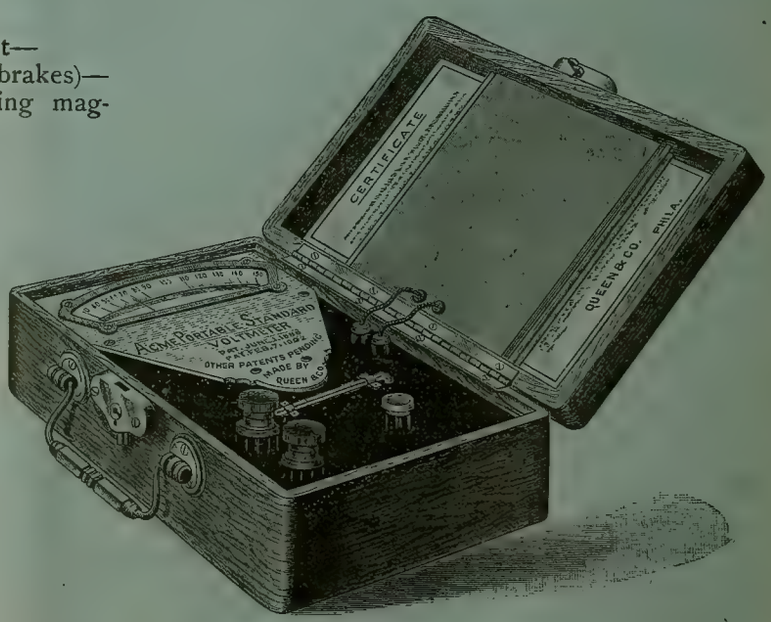

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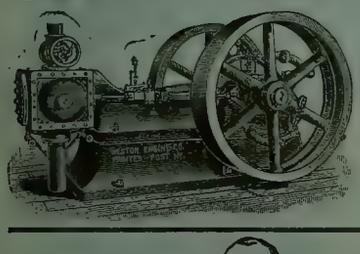

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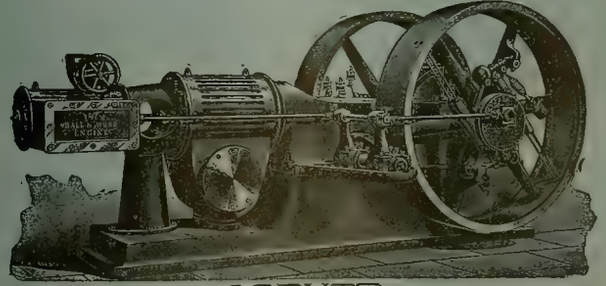

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14 James St., Seattle, Wash.
Electric Bldg., Helena, Mont.
425 Wood St., Pittsburg, Pa.
18 South St., Baltimore, Md.
244 W. Fayette St., Syracuse, N. Y.

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Electric Storage Battery Co.

Adjusters, Lamp
Dow Adjustable Lt. Co.

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Central Electric Co.
Electric Appliance Co.
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Taylor, Dee & Mack.
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Arc Lamps.
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Arc Light Cord.
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Electric Appliance Co.

Armature Winders.
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Link Belt Machinery Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Brass Goods.
Lunkenheimer Co., The.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
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Western Electric Co.
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Bishop Gutta Percha Co.
Carter & Co.. Geo. G.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
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Taylor, Dee & Mack.
Western Electric Co.

Carbons, Points & Plates.
Central Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co
Western Electric Co.

Car-Heaters, Electric.
Consolidated Car-Heating Co.

Clutches, Friction.
Falls Rivet & Machine Co.
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Link Belt Machinery Co.

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Western Elec. Supply Co.

Cross-Arms, Pins and Brackets.
Adams, W. L. & Co.
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Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Taylor, Dee & Mack.

Cut-Outs and Switches.
Adams, W. L. & Co.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Iona Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Perkins Elec. Switch Mfg. Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Washington Electric Co.
Western Elec. Supply Co.

Desk Lights.
McLeod. Ward & Co.

Dynamos.
Brush Electric Co.
C. & C. Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Fort Wayne Electric Co.
General Electric Co.
Gregory, Chas. E. Co.
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Rose Elec. Light Supply Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Electric Railways.
Brush Electric Co.
Complete Elec. Const. Co.
General Electric Co.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Allen-Hussey Co.
Amstutz, N. S.
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Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Complete Elec. Const. Co.
Comstock, Louis K.
Goltz, Wm.
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Monrath, Gustave.
Osborne Steam Eng. Co.
Osburn, Harry G.
Stone, O. M.
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Electrical Instruments.
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Bernard Co., The E. G.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Iona Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
McLeod, Ward & Co
McMillan, Hugh.
Queen & Company, Incorp.
Taylor, Dee & Mack.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.
Wirt, Chas.

Electrical Specialties.
Andrews & Haschke.
Capitol Model & Mach. Wks.
Electric Appliance Co.
Holtzer-Cabot Electric Co.
McLeod, Ward & Co.
Washington Electric Co.

Electric Slate.
Independent Electric Co.
Taylor, Dee & Mack.

Electroliers, etc.
Baggot, E.
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Gleason, E. P. Mfg Co.

Electro-Plating Mach'y.
Colburn Electric Mfg. Co.

Elevators, Electric.
Morse, Williams & Co.

Engines, Steam.
Ball & Wood Co., The.
Ball Engine Co.
Case, J. T. Engine Co.
Freeman Sons Mfg. Co.
Weston Engine Co.

Fan Outfits.
Diehl & Co.

Fibre.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

Fire Alarms.
Western Electric Co.

Fuse Wire.
Electric Appliance Co.
Independent Electric Co.

Gas Lighting, Electric.
Holtzer-Cabot Electric Co.

Gears.
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General Elec. Supplies.
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Hayden-Booker Mfg. Co.
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Iona Mfg. Co.
Law Battery Co.
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Manhattan Elec. Sup. Co.
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Globes and Electrical Glassware.
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Hemingray Glass Co.

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Dixon Crucible Co., Jos.

Hard Rubber Goods.
Newton Rubber Co.

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Andrews & Haschke.
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Push Buttons.
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Innis & Co.
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Stilwell & Bierce Mfg. Co.

Universities.
Correspondence School of Technology.
Institute of Technology.

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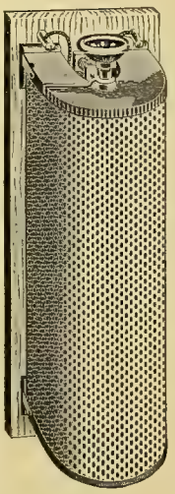

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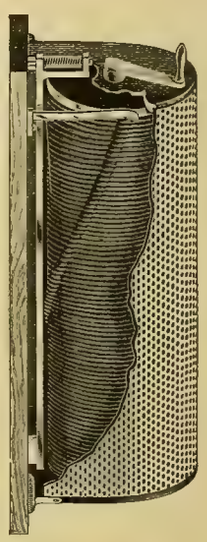

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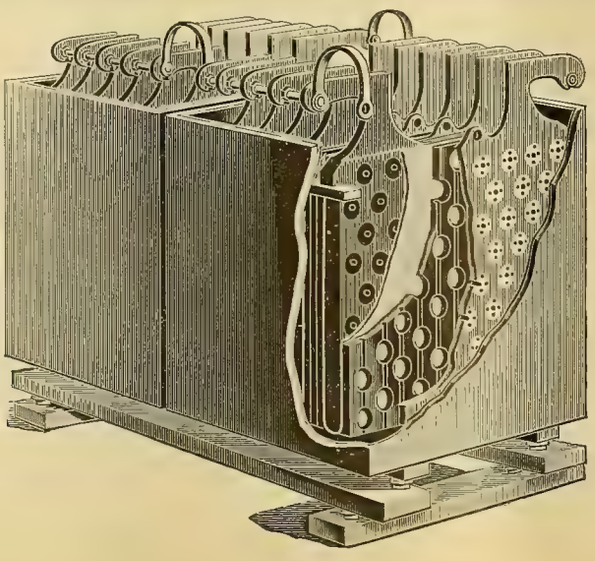

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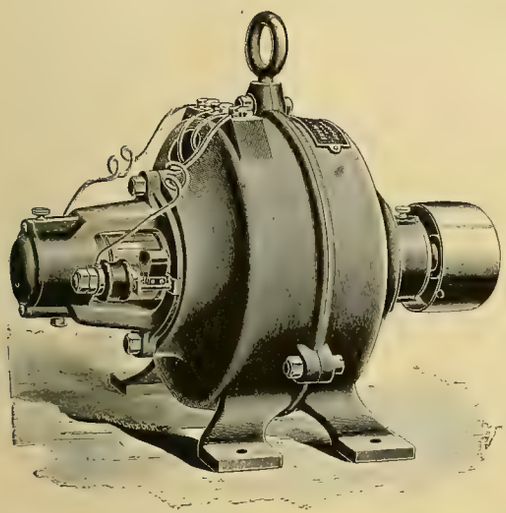

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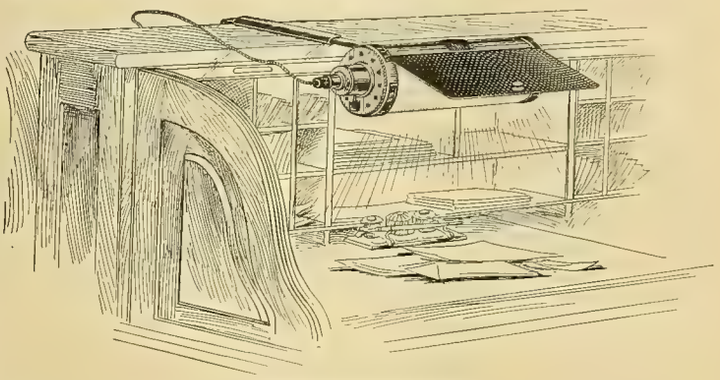

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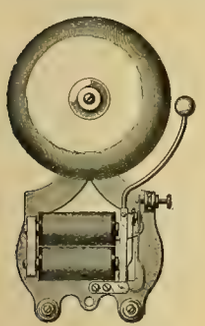
Improved Duplex Magnet Dust-Proof Bell.



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METAL SHEATHED BUSHINGS.

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St. Louis: Southern Electrical Supply Co.

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THE ELECTRIC STORAGE BATTERY CO.,

W. W. GIBBS, President.
HERBERT LLOYD, F. C. S., General Manager.

SOLE MANUFACTURERS OF

THE CHLORIDE ACCUMULATOR,

DREXEL BUILDING, PHILADELPHIA.

We see in your issue of March 17, an advertisement of a storage battery company in which they refer indirectly to the challenge made by the Electric Storage Battery Company, and make certain excuses for not being willing to enter into a competition such as we proposed, stating that they are ready to spend money to demonstrate the value of their cells in actual service, but have no money to spend for drawn out and in the end valueless tests, as far as durability and efficiency in actual service are concerned.

In order to meet a case of this kind, we propose to this battery company that they may name the conditions under which they would consider a test practicable to determine the relative commercial value.

We make the claim that our battery has more than 50 per cent. greater commercial value than the battery referred to, or any other battery manufactured in this country, and are prepared to meet any conditions necessary to determine the correctness of our statement.

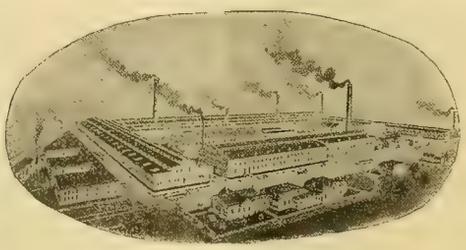
We know from past experience and statements that have been made by manufacturers of storage batteries, from time to time, that claims such as are made by this company without some reliable means of verification, are of no value.

We know we have the best battery, and we are willing to adopt any means and meet any conditions which will enable the public to determine the fact.

Very truly yours, **W. W. GIBBS**, President,
ELECTRIC STORAGE BATTERY CO.

Electric Motors and Generators.

Arc Lighting Apparatus.



Arc Lamps.

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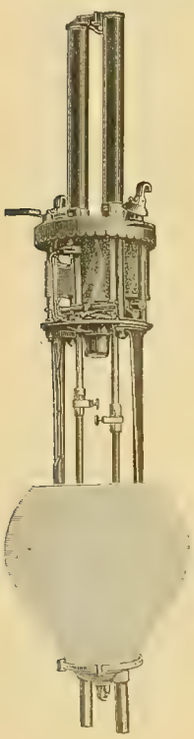
Alternating Current Apparatus.



THE BRUSH ELECTRIC COMPANY,

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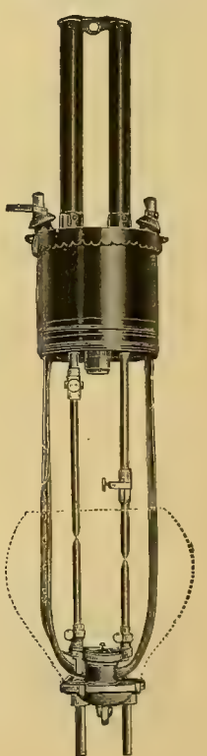
SOMETHING NEW.

An Arc Lamp without Spring, Wax, Glycerine or Mercury.

Send for Samples of the

NEW BRUSH ARC LAMP.



THE ONLY LAMP FOR ALL-NIGHT LIGHTING.

SPECIAL BARGAIN SALE.

Recognizing that times are a little dull, and that every one wants to buy the

BEST GOODS AT THE LOWEST PRICES,

We wish to announce to the Electrical Trade that we offer at special prices,

1,000 WARD LAMPS,

direct current, two in series, either 6 1-2, 8 or 10 amperes.

We are the Pioneers

in this business, and INTEND TO REMAIN IN IT.

If you can use any low tension arc lamps for DIRECT CURRENT, write us and let us know what your views are as to prices. We are willing to meet the trade on any reasonable basis on this special lot of 1,000 lamps.

FIRST COME, FIRST SERVED.

Bear in mind, also, that we manufacture arc lamps of all styles for constant potential circuits.

ELECTRIC CONSTRUCTION & SUPPLY COMPANY,

UNITY BUILDING, CHICAGO, Established 1881. TELEPHONE BUILDING, NEW YORK.

BUCKEYE INCANDESCENT LAMPS TO FIT ANY STANDARD SOCKET.

Judge Ricks' decision against the Edison Company and in our favor, frees these lamps from any taint of infringement. Order no other.

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COMPLETE ELECTRIC EQUIPMENTS FOR LIGHTING AND POWER PURPOSES.

Dynamos from 50 to 5,000 Lights. Motors from 1 to 300 Horse Power.

Street Railway Generators and Station Equipment from 50 to 500 K. W.

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Trolley Line Insulators,
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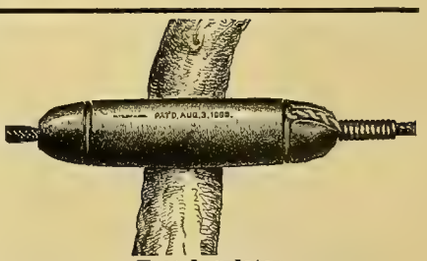

Tree Insulator.
Perfect Protection.

H. W. JOHNS MANUFACTURING CO.,

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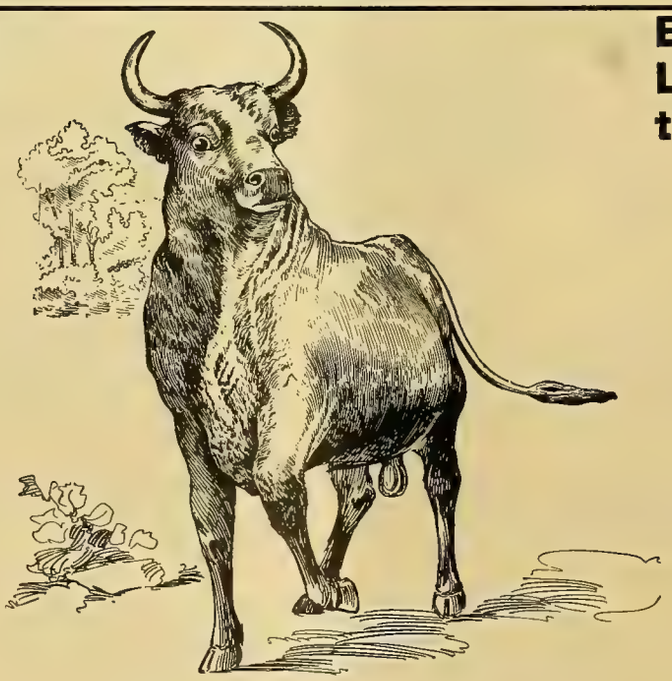
Don't make a Alternating Arc investigating



By Buying any Lamp before the

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Everything about it is of the very best. Brass Frame, Brass Shell, Brass Cap, Brass Rods. No tin or stovepipe iron. It combines unequaled simplicity with absence of all objectionable features heretofore present in alternating lamps. It is a **NON-STICKER** that central station men and lamp trimmers will be **STUCK** on because they don't have to **MONKEY** with it every few days, taking it down to clean and oil. Lamps for all systems. We guarantee every lamp. Write for prices.

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Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
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Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Out Last and Out Class any other on the Market.

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We are prepared to furnish first-class telephone receivers in quantities at very low prices.

Our complete outfit, including transmitter, receiver and signaling apparatus, will be ready for delivery after February 15th. These outfits will have an automatic circuit-changing device, which we guarantee is no infringement.

We are headquarters for telephone receiver shells, permanent bar magnets, magneto bells, line material, etc.

THE MESCO DRY BATTERY

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GET OUR PRICES on Leclanche batteries, zincs, Manhattan door opener (no push-out spring required), watchman's clocks (just out). Special low prices on speaking tubes, whistles, bronze push buttons and annunciators. We have a **Job lot** of spun, bronze and nickel plated push buttons.

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Manufacturers of the

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ELECTRIC TRANSMISSION HAND-BOOK.

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NOW READY. PRICE $1.00.

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EVERYBODY'S BUSINESS.

Still, we undoubtedly get a large share of it, and make those who place all of their orders with us

PARTICULARLY HAPPY

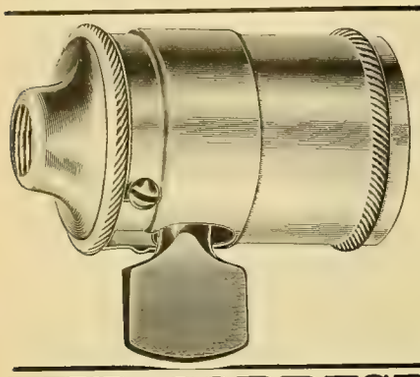
So that we probably have no reason to complain.
The purpose of the above soliloquy is to call your attention in a quiet way to the fact that we ought to

HAVE YOUR BUSINESS.

If a mere statement of this fact is not sufficient send us your next order and be convinced.

ELECTRIC APPLIANCE COMPANY,

ELECTRICAL SUPPLIES. 242 Madison Street, CHICAGO.



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Representative work now in course of construction, 2 000 H. P. Heat, Light and Power Plant for the Pabst Heat, Light & Power Co., Milwaukee, Wis.

Those who contemplate the construction of similar plants on improved and economical lines will do well to communicate with us. First, be sure you will get the best, then go ahead.

Don't Make a Blunder!

But have your burned-out armature rewound by us with our

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Satisfaction guaranteed in all Electrical repairing. Storage batteries recharged and repaired.

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THE BEST GRADES OF

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For under ground, under water, and all other conditions.

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Manufacture under their **own patents Arc Lighting Apparatus** for every purpose. The **Clark** Alternating Current Arc Lamps and the **Clark** Arc Lamps for Incandescent Circuits are known to be the most reliable and durable ever made, **and lead** all others in cheapness to the user. Our Arc Lamps for high tension are the steadiest ever made. **Our reference is our customers.**

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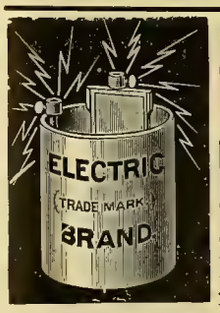

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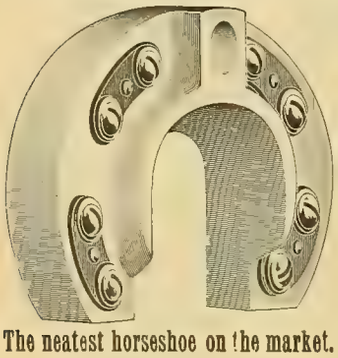

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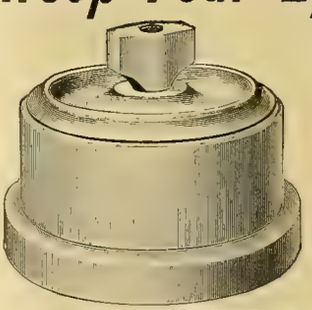

And we will show you a picture of each one of our

NEW INCANDESCENT SWITCHES,

Flush Switches,
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Key Switches,

Which we make in *SINGLE AND DOUBLE POLE*, in all sizes.

Also: **Sockets,** to fit all bases, key and keyless, key and keyless wall.

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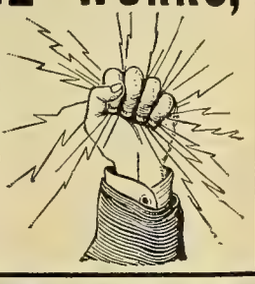

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For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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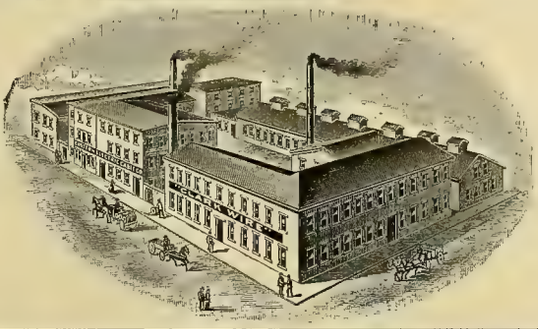

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We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

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ESTABLISHED 1873.
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In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

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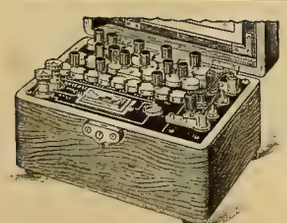

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Were granted an award at the World's Fair for

EXCELLENCE OF DESIGN, CONSTRUCTION, CONVENIENCE IN USE.

THEY ARE specially adapted for constant switchboard use.
WE ARE ready to contract with dynamo and motor builders and construction companies at special prices.

Send for Circular No. 522.

We make all kinds of electrical measuring instruments. Cata'ogue "T" will be mailed free ONLY if this ad. is mentioned.

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A number of new special single and double pole brackets; will close out at a low figure; write for description.

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In alternators we have 300 T.-H., 500 and 750 Westinghouse 1, 2 and 3,000 Slattery.
In arc 20, 30 and 45 Brush, 25 and 50 T.-H. and a lot of T.-H arc lamps, K2 and D.

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Controlling stock in a gas and electric light plant.

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Position by an electrical engineer of acknowledged ability, either as electrician or superintendent of an electric railway, or would engage in the construction of a road for new company. Have had several years' practical experience in above capacities; thoroughly understand the care and management of railway motors, and repairs of same including armature rewinding, etc. Have made a specialty of General Electric and Westinghouse systems. Good reasons for desiring to change present position. Reference. Address **"Westinghouse,"** care WESTERN ELECTRICIAN, 6 Lakeside Building, Chicago.

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Harrodsburg Elec. Light & Power Co.,
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The Chicago, Milwaukee & St. Paul Railway is now running sleeping cars with drawing rooms on night trains between Chicago and Milwaukee. Sleepers can be taken in Union Passenger Station any time between 9:30 and midnight, train leaving Chicago at 3:00 a. m., arriving at Milwaukee at 5:15 a. m., passengers remaining in sleeper until 7:30 a. m. Similar arrangements Milwaukee to Chicago. Berth rate $1.50. For further particulars, for tickets and berths, apply at City Ticket Office, 207 Clark St (Telephone Main 2190), or at Ticket Office, Union Passenger Station.

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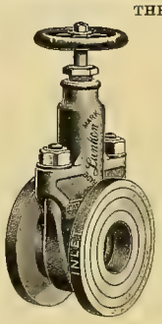

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The **Valve Wonder** of the age. Simple, practical, compact, durable, low-priced. For light and heavy pressure. From ½ inch to 12 inches. **Satisfaction guaranteed.** Circulars and prices on request.

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The Standard Open Circuit Batteries of the World.
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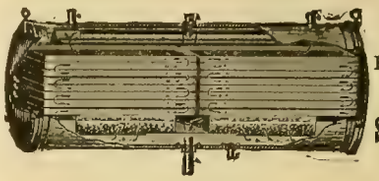

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Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

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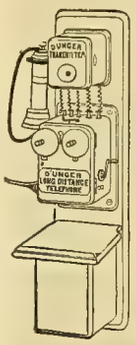

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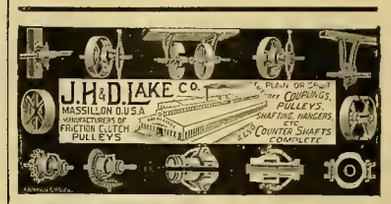

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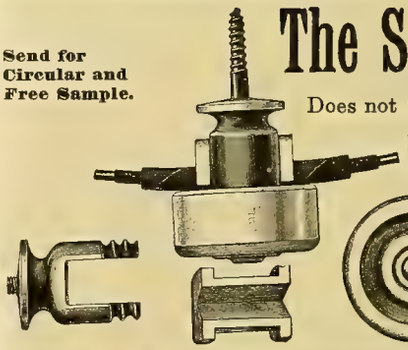

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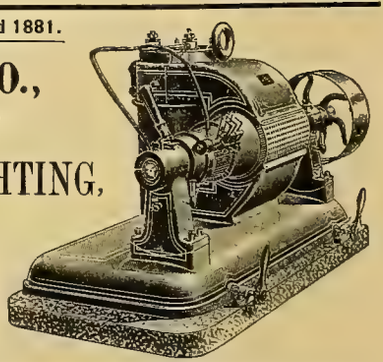

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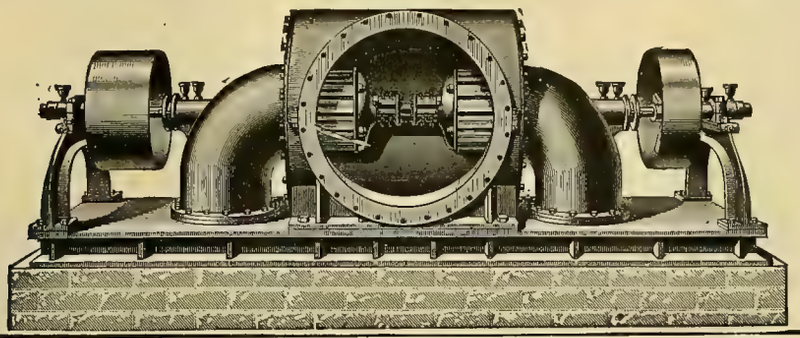

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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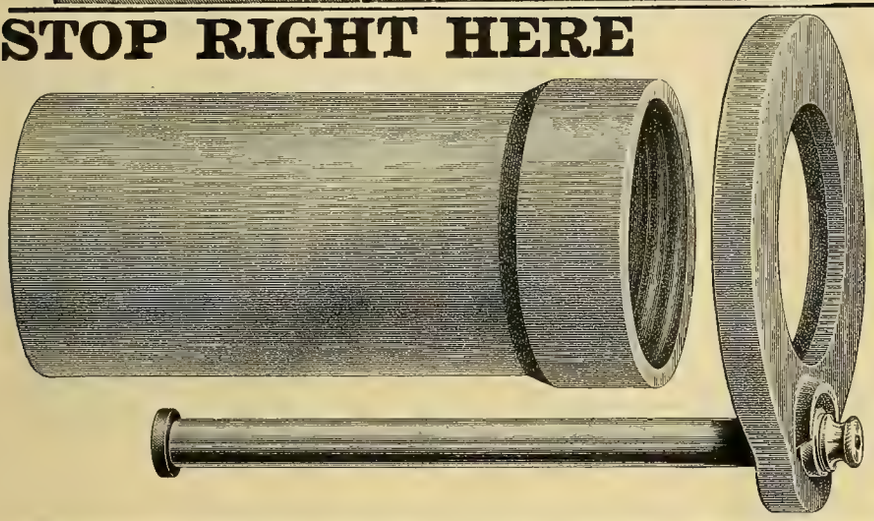
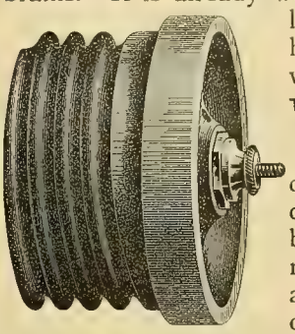


And take a look at the latest emanation from our brains. It is already well known throughout the land, but you may not have heard of it; therefore, we would say it is



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The illustration shows the carbon porous cup of the cell, with its removable carbon cover, which allows the removal of the depolarizing agent whenever it has become exhausted or deteriorated through over work. It also shows the jar cover carrying the zinc rod. Further comment is unnecessary. You will readily see that we have a good thing.

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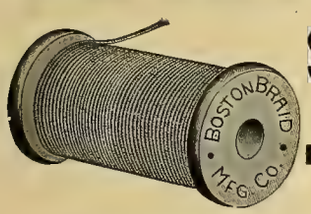

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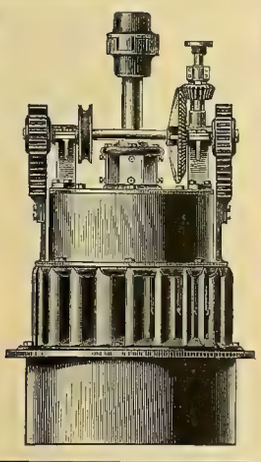

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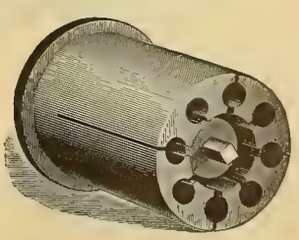

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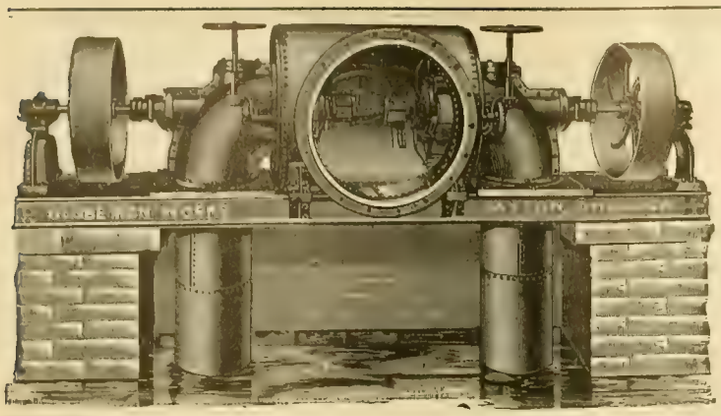

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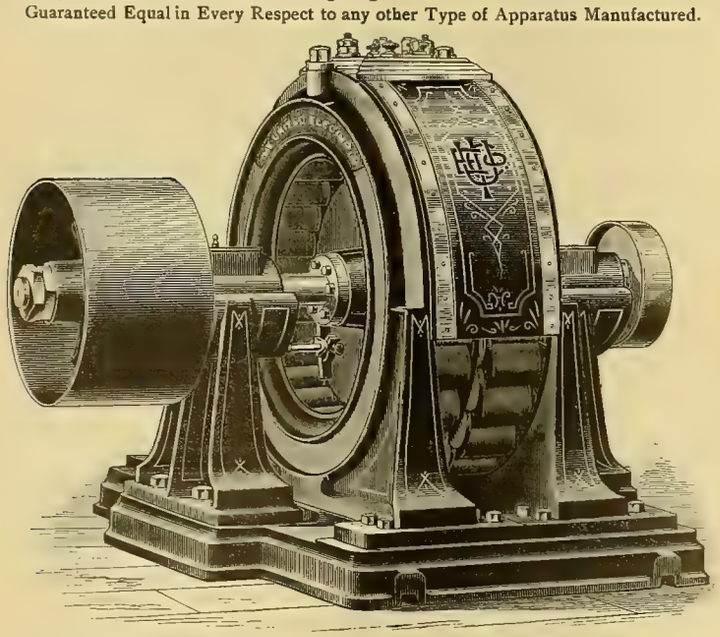

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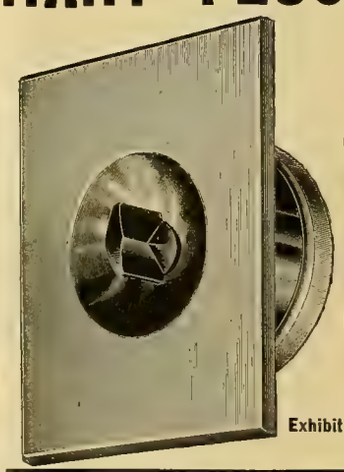

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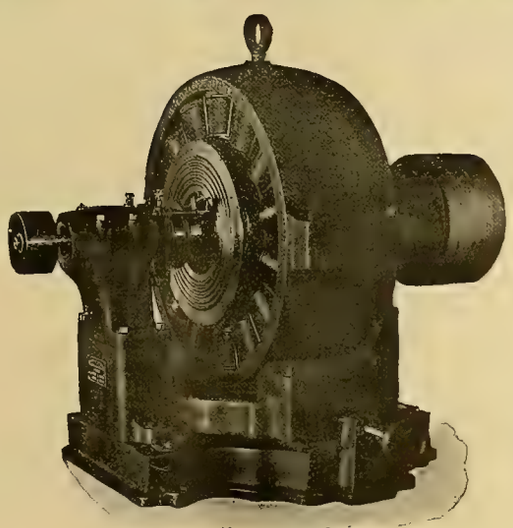

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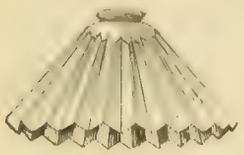

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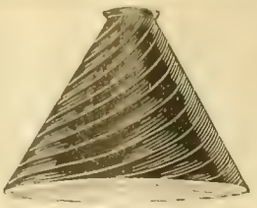

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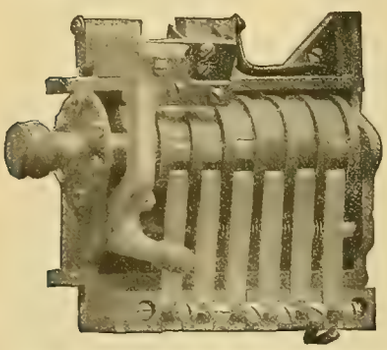

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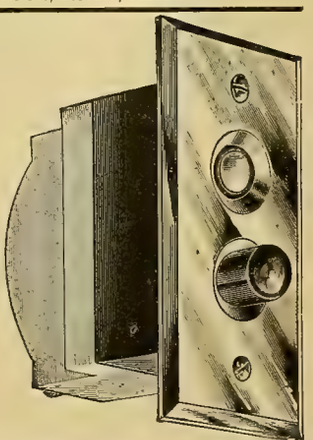

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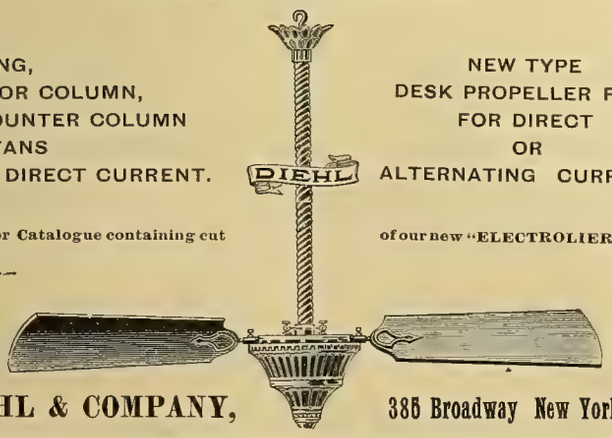

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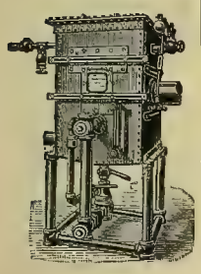

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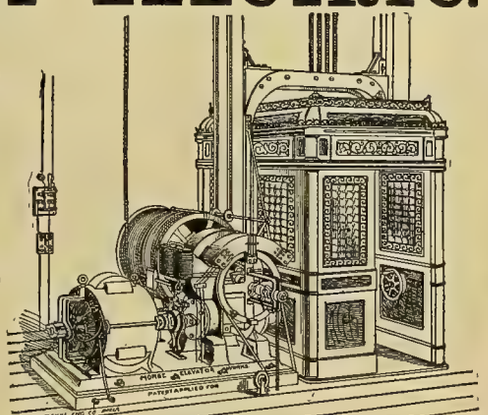

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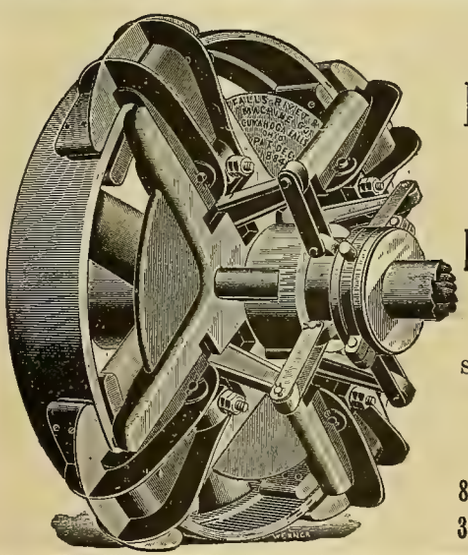

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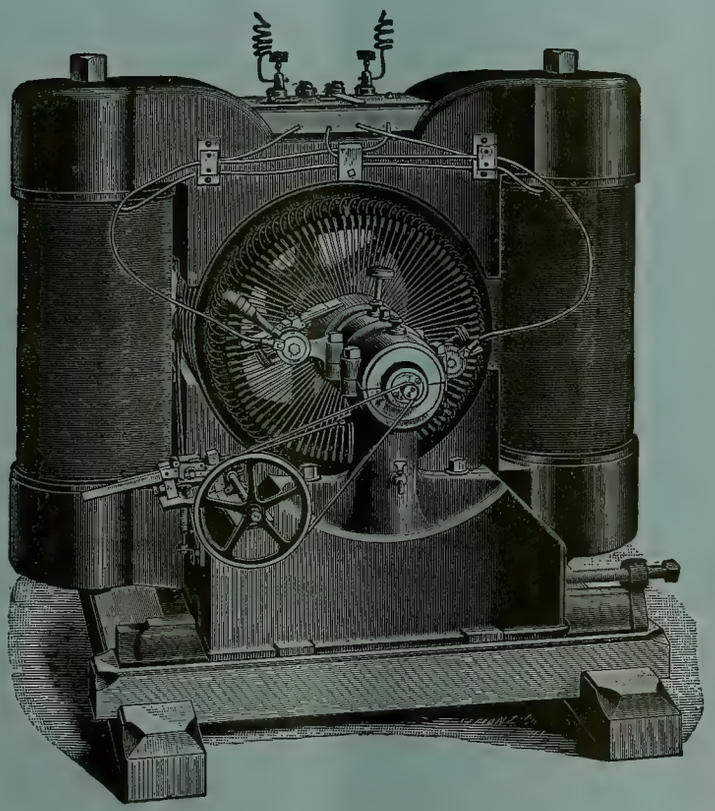

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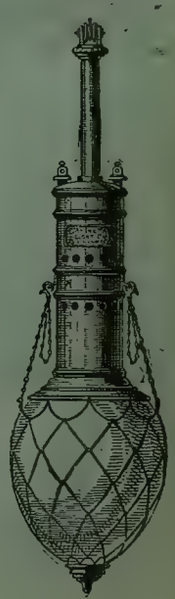

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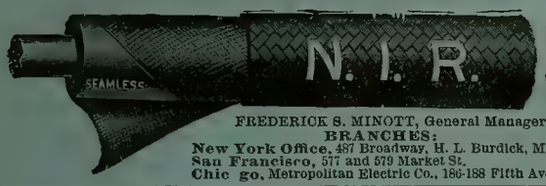

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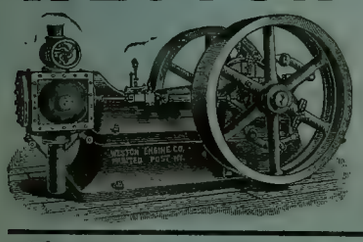

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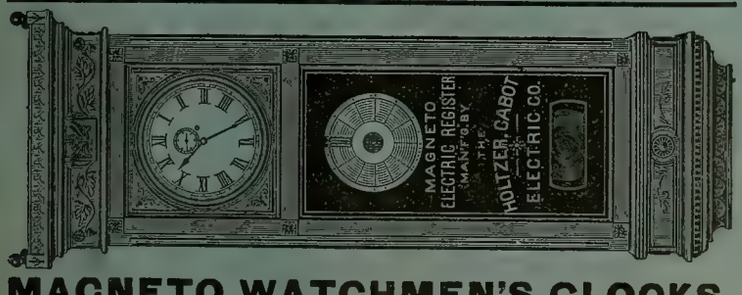

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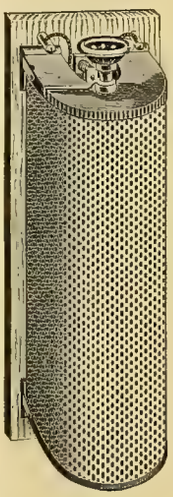

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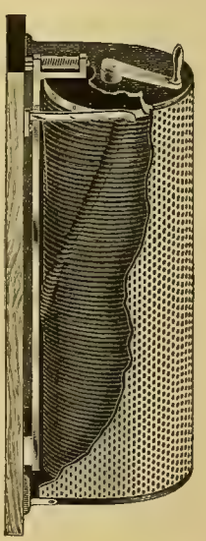

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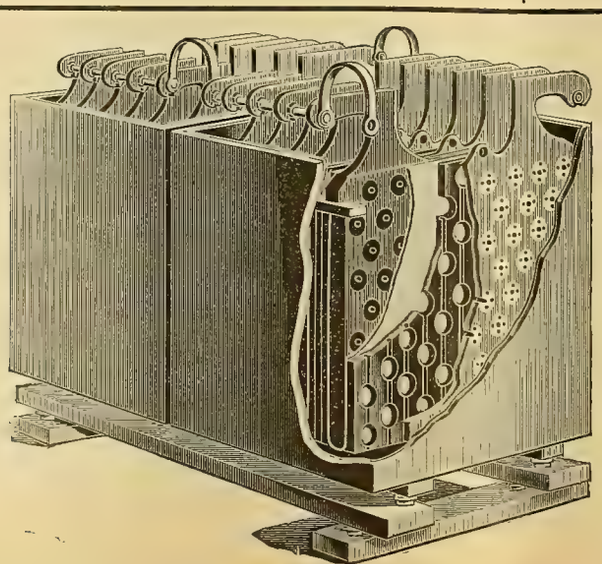

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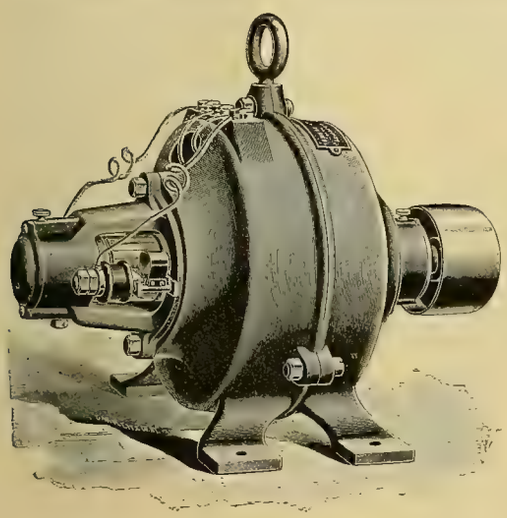

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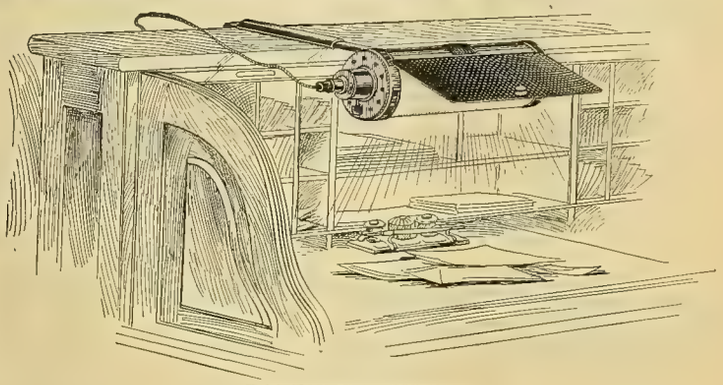

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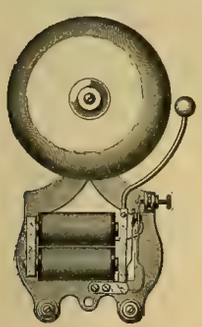

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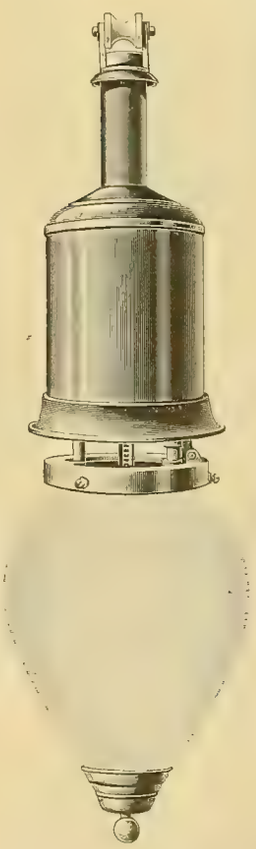

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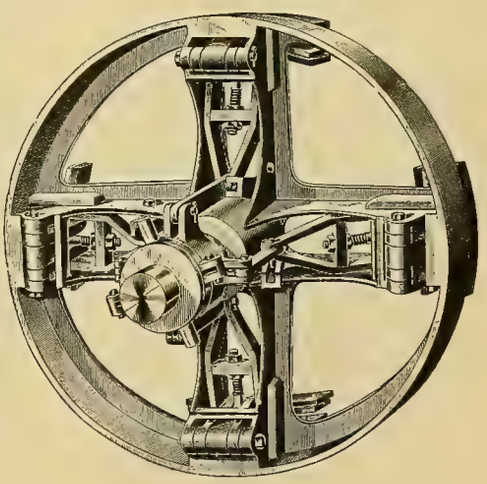

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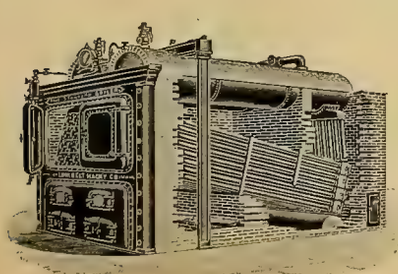

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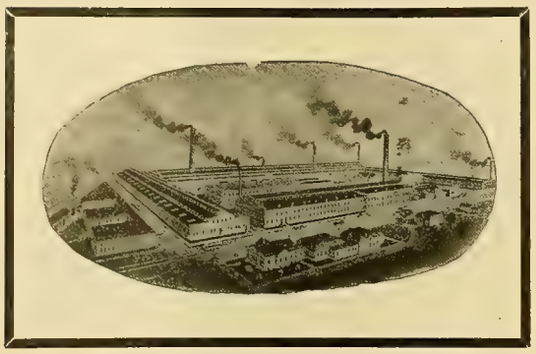

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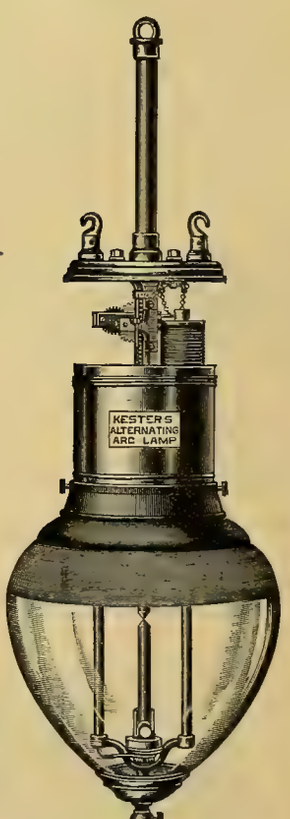

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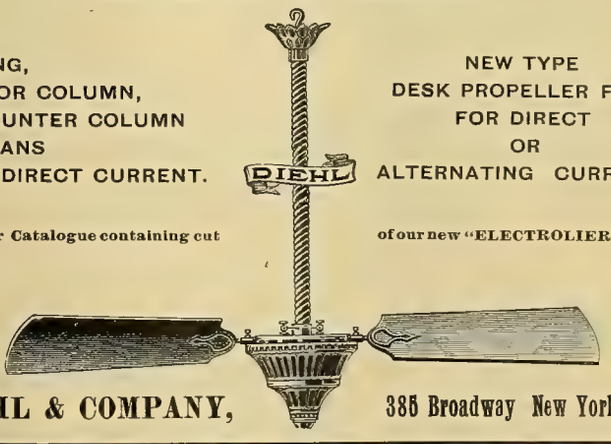

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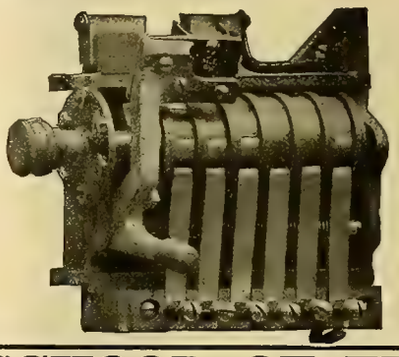

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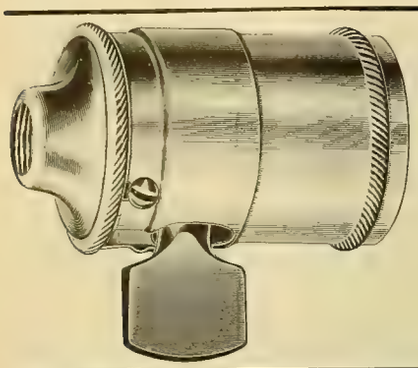

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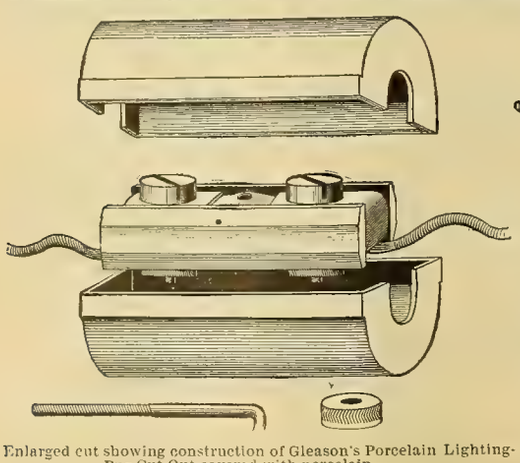

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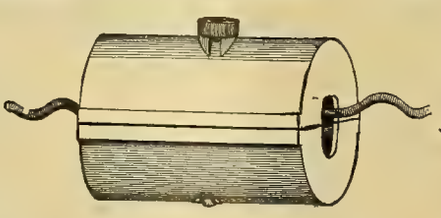

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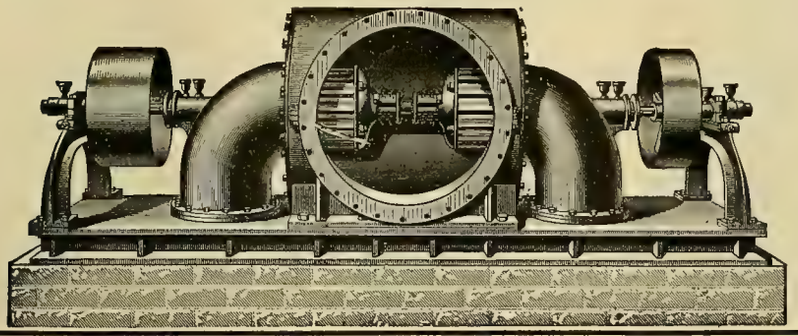

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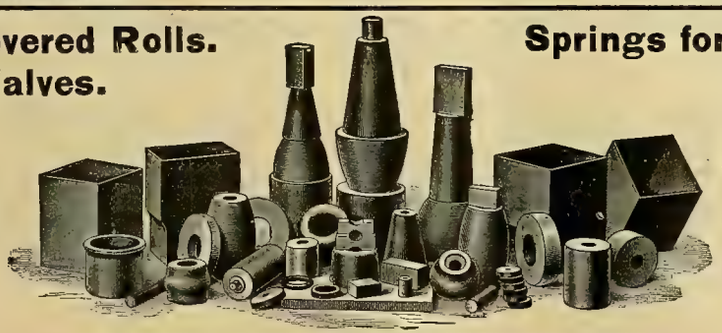

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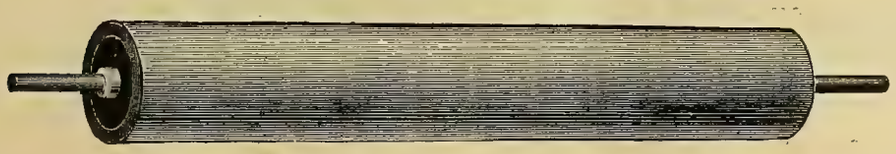

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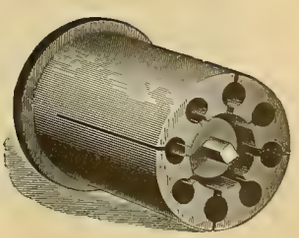

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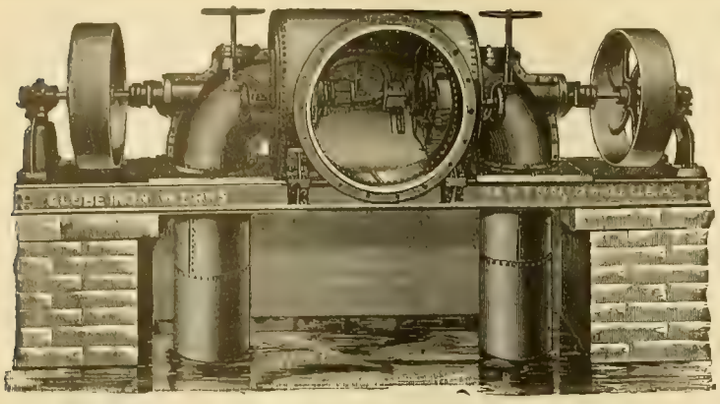

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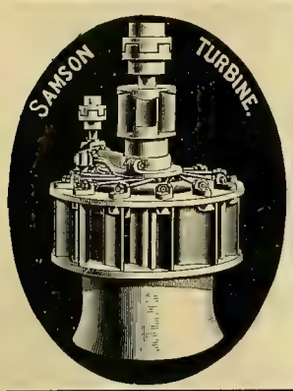

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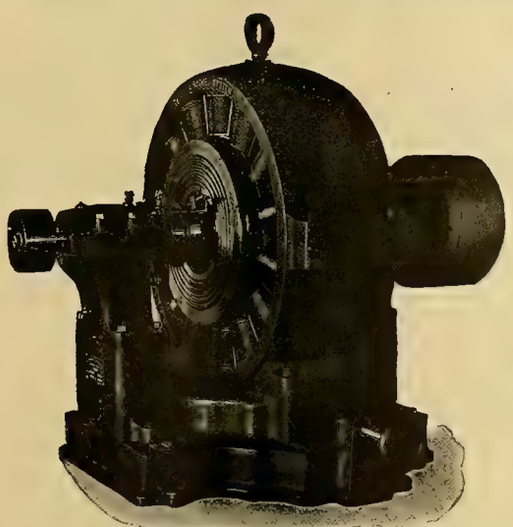

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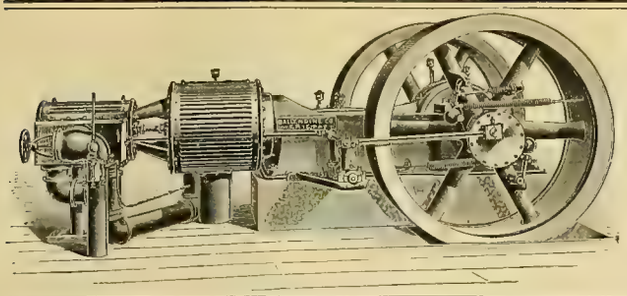

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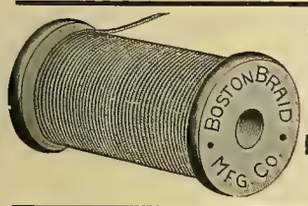

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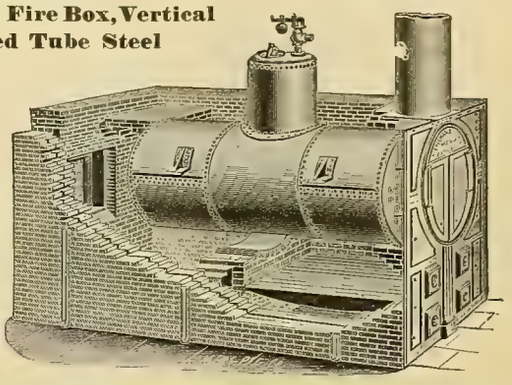

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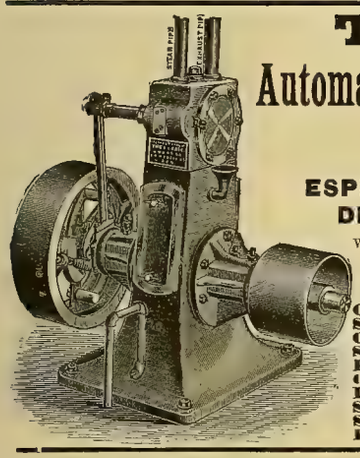

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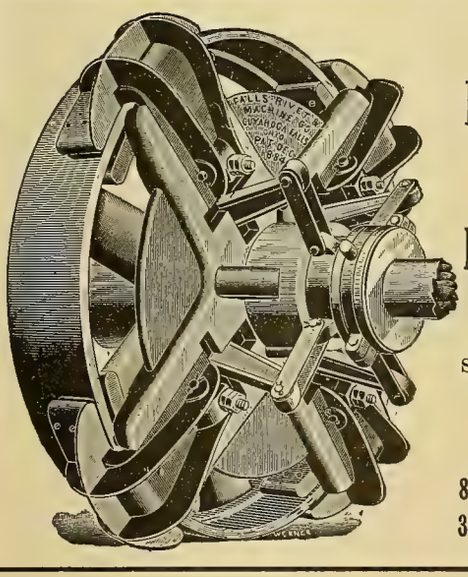

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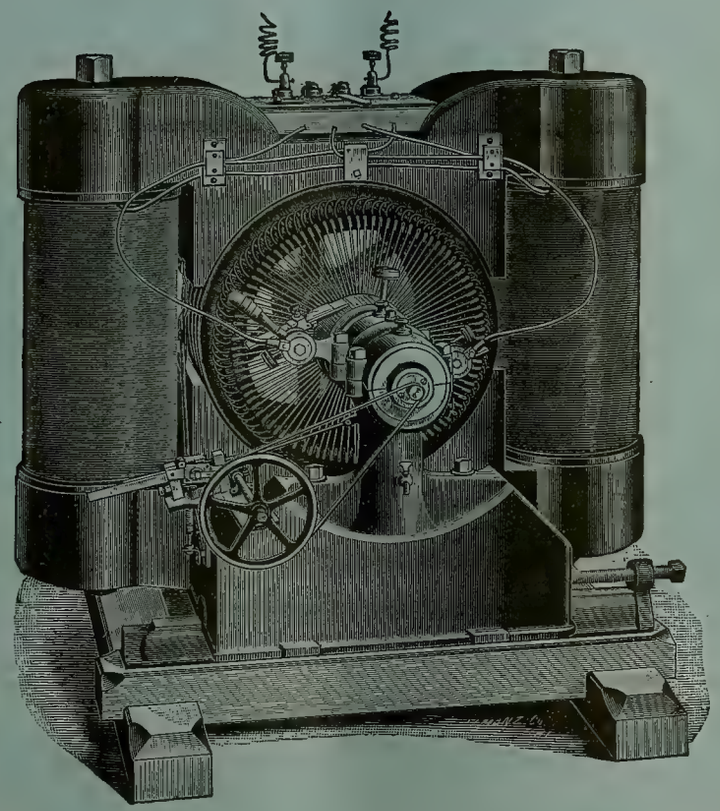

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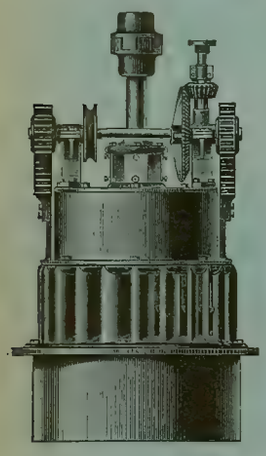

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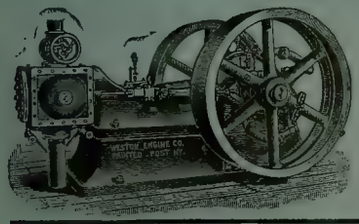

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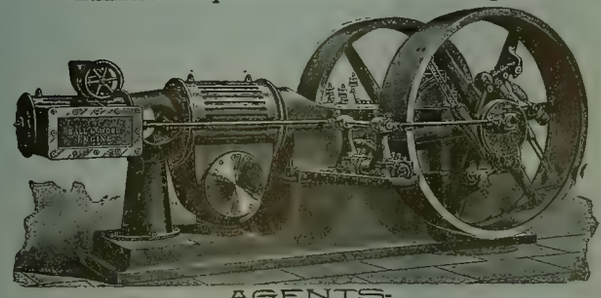

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Case, J. T. Engine Co.
Freeman Sons Mfg. Co.
Weston Engine Co.

Fan Outfits.
Diehl & Co.

Fibre.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

Fire Alarms.
Butler Hard Rubber Co.
Columbia Rubber Wks. Co.
Western Electric Co.

Fuse Wire.
Electric Appliance Co.
Independent Electric Co.

Gas Lighting, Electric.
Ansonia Electric Co.
Holtzer-Cabot Electric Co.

Gears.
Grant, Geo. B.

General Elec. Supplies.
Anderson, Albert & J. M.
Ansonia Electric Co.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Central Electric Co.
Colburn Electric Mfg. Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Hayden-Booker Mfg. Co.
Holtzer-Cabot Electric Co.
Law Battery Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
McMillan, Hugh.
Queen & Co., Incorp.
Sioux City Elec. Supply Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason E. P. Mfg. Co.
Hemingray Glass Co.

Graphite Specialties.
Dixon Crucible Co., Jos.

Hard Rubber Goods.
Butler Hard Rubber Co.
Columbia Rubber Wks. Co.
Delaware Hard Fibre Co.
Newton Rubber Co.

Insulators and Insulating Materials.
Anderson, Albert & J. M.
Andrews & Haschke.
Ansonia Electric Co.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Columbia Rubber Wks. Co.
Cutter Elec. & Mfg. Co.
Delaware Hard Fibre Co.
Electric Appliance Co.
Empire China Works.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Moore, Alfred F.
Munsell & Co., Eugene.
McLeod, Ward & Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.
Vulcanized Fibre Co.
Western Elec. Supply Co.

Insulated Wires and Cables—Magnet Wire.
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co.. J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
McMillan. Hugh.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent.
Am. Electric Mfg. Co.
Beacon Vacuum Pump & Electrical Co.
Bernstein Electric Co.
Buckeye Electric Co
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Lasell & Co., Edw.
Mather Electric Co.
Metropolitan Electric Co.
New York and Ohio Co.
New York Electric Co.
Royal Arc Electric Co.
Taylor, Dee & Mack.
Westinghouse Elec. & Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Wirt, Chas.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Link Belt Machinery Co.

Mica.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
General Electric Co
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
McMillan, Hugh.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Westinghouse El. & Mfg. Co.

Paints.
Standard Paint Co.

Patents.
Stocking, E. B.

Phosphor Bronze.
Phosphor Bronze Sm.Co.,Ltd.

Platinum.
Baker & Co.

Porcelain.
Empire China Works.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electric Appliance Co
Huebel & Manger.
Metropolitan Electric Co.

Rheostats.
General Electric Co.
Washington Electric Co.

Sal Ammoniac
Innis & Co.
Klipstein, A. & Co.
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Hayden-Booker Mfg. Co.

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Boston Braid Mfg. Co.

Slate.
Independent Electric Co.

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Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co. Incorp.
Whitney Elec. Instrument Co.

Steam Heating.
Webster & Co., Warren.

Steam Pumps.
Worthington, Henry R.

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Bradbury-Stone Elec. S. Co.
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Stoves, Electric.
Consolidated Car-Heating Co

Street Cars.
Brill, J. G. Co. []

Tapes, Insulating.
American Electrical Works.
Ansonia Electric Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Paint Co.
Taylor, Dee & Mack.

Telegraph Apparatus.
Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

Telephones.
Columbia Rubber Wks. Co.
D'Unger Elec. Tel. Mfg. Co.
Harrison Int. Telephone Co.
Lasell & Co., Edw.
Manhattan Elec. Sup. Co.
Western Electric Co.
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Stanley Electric Mfg. Co.
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General Electric Co.
Westinghouse El. & Mfg. Co.

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Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
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Water Heaters.
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Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co
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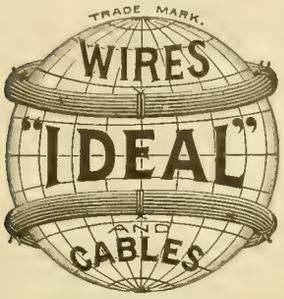
TO FIT ANY STANDARD SOCKET.

Judge Ricks' decision against the Edison Company and in our favor, frees these lamps from any taint of infringement. Order no other.

MONADNOCK BUILDING, CHICAGO.

THE BUCKEYE ELECTRIC CO., Cleveland, O.



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Best Substitute for Rubber.

HIGH INSULATION. LONG LIFE. LOW COST.

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Push Buttons

FOR

60 DAYS.

The finest designs and best assortment ever offered. Can make immediate shipments of every kind from stock.

ASK FOR QUOTATIONS, STATING QUANTITY.

Also a complete line of Electric House Goods at the same reduction.

HUGH McMILLAN,

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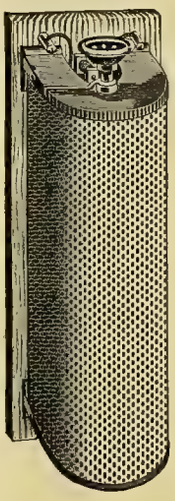
Rheostat and Stage Dimmer.



Contact made on wires direct instead of on segment face.

Changes from light to dark and vice versa, made perfectly even and gradual.

Finest scenic effects produced without difficulty.

INCOMBUSTIBLE, DURABLE, COMPACT and REASONABLE IN PRICE.

Meissner's Improved Theatrical Focusing Lamp—best in the world.

Meissner's Focusing Lamp for photo-engraving and stereoscopic work has no equal.

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WASHINGTON ELECTRIC CO.,

197 and 199 S. Canal St., Chicago.

DON'T

Place your order for Converters until you have investigated **THOROUGHLY** claims made by us.

HORNBERGER ELECTRIC MFG. CO.,

ELKHART, - - - INDIANA.

1894. APRIL. 1894.

SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.
1 (91)	2 (92)	3 (93)	4 (94)	5 (95)	6 (96)	7 (97)
8 (98)	9 (99)	10 (100)	11 (101)	12 (102)	13 (103)	14 (104)
15 (105)	16 (106)	17 (107)	18 (108)	19 (109)	20 (110)	21 (111)
22 (112)	23 (113)	24 (114)	25 (115)	26 (116)	27 (117)	28 (118)
29 (119)	30 (120)					

JANUARY

SU	M	TU	W	TH	F	SA
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7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

FEBRUARY

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MARCH

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APRIL

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29	30					

MAY

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JUNE

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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

COMBINATION CALENDAR TABLET
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JULY

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

AUGUST

SU	M	TU	W	TH	F	SA
			1	2	3	4
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26	27	28	29	30	31	

SEPTEMBER

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30						

OCTOBER

SU	M	TU	W	TH	F	SA
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7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

NOVEMBER

SU	M	TU	W	TH	F	SA
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4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

DECEMBER

SU	M	TU	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

MOON'S PHASES.	NEW MOON.	FIRST QR.	FULL MOON.	LAST QR.
	5th	12th	19th	27th

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When You Should Send Us Your Order For

ALL ELECTRICAL SUPPLIES.

Send for Catalogue if you have not one already.

To Be Closed Out May 1st.

For the Next Month, Goods

AT COST.

Buy your material for Spring Construction of us. Look at Sample Prices below. Everything else in proportion.

Lamp Cord	**70 per cent. from Manufacturers' List.**
D. P. D. G. Insulators	**$28.00 per M, net.**
Standard No. 4 Porcelain, our No. 962	**4.00 per M, net.**
All Porcelain Insulators	**60 per cent. discount.**
High Insulation Brackets	**40 per cent. discount.**
Socket Insulating Bushings	**$1.25 per C.**

Our prices are ***SPOT CASH*** and this advertisement must be mentioned to obtain this greatly reduced price list. We positively cannot exchange any of these goods as they are all standard stock and we promise that they are in good condition when leaving our hands. Entire stock for sale in part or bulk, and stock always open for examination.

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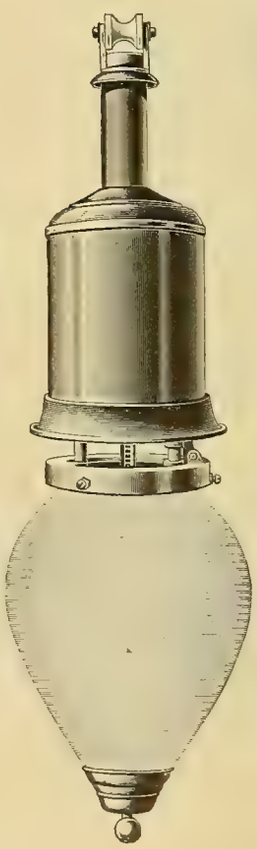
(FORMERLY THE ELECTRICAL SUPPLY CO.),

RANDOLPH ST. AND MICHIGAN AVE., CHICAGO.

JAMES B. WALLER, Assignee.

THIS LAMP IS A "CINCH."



PIONEERS IN THE BUSINESS.

SIMPLICITY OF CONSTRUCTION has always been our aim, and our New Alternating Lamp, as shown herewith, is by far the simplest arc lamp ever manufactured.

Arc Lamps for { **INCANDESCENT CIRCUITS.** / **RAILWAY CIRCUITS.** / **ALTERNATING CIRCUITS—Secondary**

And a full line of lamps for special purposes, including Photo-Engraving, Stereopticon, Ophthalmoscopic, Theatrical, Search Lamps, etc., etc.

Write for Catalogue.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

TELEPHONE BUILDING, NEW YORK. Established 1881. UNITY BUILDING, CHICAGO.

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Engineers—Founders—Machinists,

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City Sales Office, 21 and 23 So. Jefferson St.,

DESIGNERS AND BUILDERS OF

Machinery for Handling Coal and Ashes.

We have equipped the power plants of the following well-known firms with machinery for handling coal from cars, barges and wagons to boilers, and for taking ashes from under boilers to dump:

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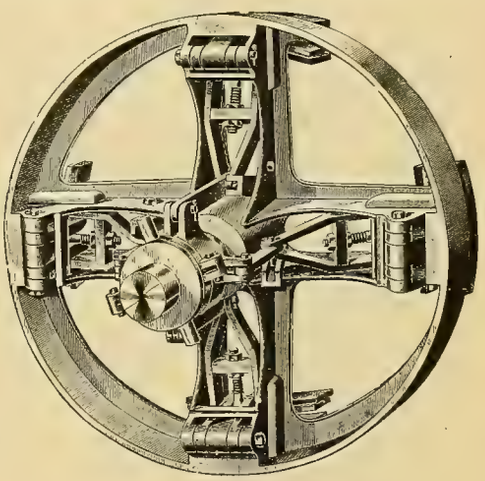
West End Street Railway Co., Boston, Mass.
New York Steam Heating Co , New York.
Washburn & Moen Mfg. Co., Waukegan, Ill.
Spreckles Sugar Refining Co., Philadelphia, Pa.
Illinois Steel Co., Joliet, Ill.
Illinois Steel Co., South Chicago, Ill.
Auditorium Hotel, Chicago.
P. Schoenhofen Brewing Co., Chicago.
Pabst Brewing Co., Milwaukee, Wis.
Franklin Sugar Refining Co., Philadelphia, Pa.
Anglo-American Packing & Provision Co., Union Stock Yards, Chicago, and many others.

SOLE MANUFACTURERS OF

The Ewart Guaranteed Friction Clutch,



Especially Designed for Heavy Duty at High Speed,
and Fully Guaranteed.

NOTE;—The Ewart is the ONLY CLUTCH which can be properly cast as a part of a driving pulley, rope sheave or gear, so that, when thrown out of engagement, the Clutch Mechanism is at rest, and accessible for adjustment, etc.

COMPLETE POWER TRANSMITTING MACHINERY

For Steam Generating Plants,

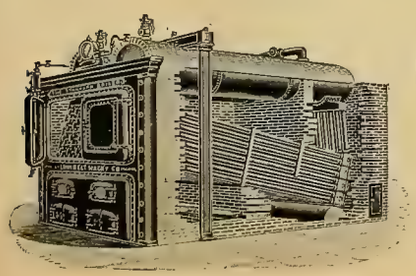
INCLUDING:

SHAFTING (IRON OR STEEL),
Up to 16 Inches in Diameter.

SHAFT BEARINGS, PULLEYS and GEARING,
Of any size, and of superior quality and design.

Rope Sheaves, Band and Fly Wheels.

Manilla Rope Power Transmissions.



The STANDARD Water Tube SAFETY Boiler.

ABSOLUTE SAFETY WITH HIGHEST POSSIBLE ECONOMY.

Correspondence Solicited.

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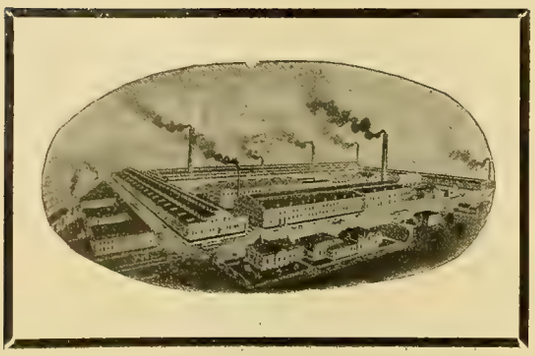
Trade-Mark.

THE BRUSH ELECTRIC CO.,

CLEVELAND, O.



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Alternating Current Apparatus,
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Arc Lamps.

Don't make a Alternating Arc investigating

By Buying any Lamp before the

MON-ARC

Everything about it is of the very best. Brass Frame, Brass Shell, Brass Cap, Brass Rods. No tin or stovepipe iron. It combines unequaled simplicity with absence of all objectionable features heretofore present in alternating lamps. It is a **NON-STICKER** that central station men and lamp trimmers will be **STUCK** on because they don't have to **MONKEY** with it every few days, taking it down to clean and oil. Lamps for all systems. We guarantee every lamp. Write for prices.

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Are Prepared to Furnish

MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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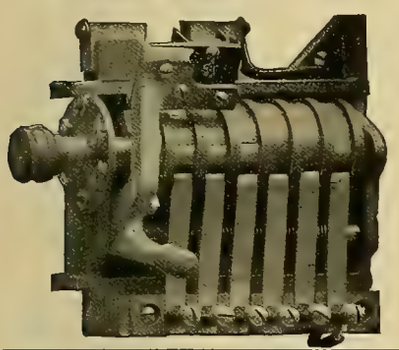
Consolidated Car-Heating Co.,

Chicago, Ill. **ALBANY, N. Y.** Coatecook, P. Q.

COMFORT. **SAFETY.**



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Regulating Switch Gives

FIVE DIFFERENT INTENSITIES OF HEAT.

In Practical Operation in More Than 25 Leading Cities in U. S. and Canada.

TELEPHONE WIRE AND CABLES.

Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Cut Last and Out Class any other on the Market.

DAYS KERITE

SEND FOR SAMPLES AND PRICES.

CUSHING & MORSE,
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W. R. BRIXEY, Mfr.
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ELECTRIC TELEPHONES.

We are prepared to furnish first-class telephone receivers in quantities at very low prices.

Our complete outfit, including transmitter, receiver and signaling apparatus, will be ready for delivery after February 15th. These outfits will have an automatic circuit-changing device, which we guarantee is no infringement.

We are headquarters for telephone receiver shells, permanent bar magnets, magneto bells, line material, etc.

THE MESCO DRY BATTERY

is recommended for telephone transmitter and all other open circuit work. **Over 200,000 in use. PRICES REDUCED,** making it the cheapest reliable open circuit battery on earth.

GET OUR PRICES on Leclanche batteries, zincs, Manhattan door opener (no push-out spring required), watchman's clocks (just out). Special low prices on speaking tubes, whistles, bronze push buttons and annunciators. We have a **Job lot** of spun, bronze and nickel plated push buttons.

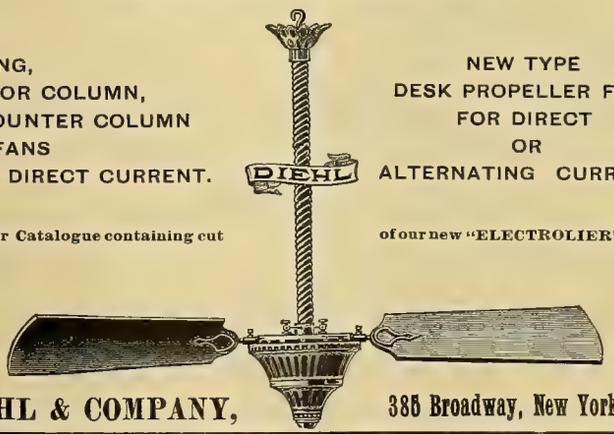
If you will send us your address we will get some of your trade.

Manhattan Electrical Supply Co.,
36 Cortlandt St., NEW YORK.

THE DIEHL ELECTRIC FANS.

NO BELTS. NO SHAFTING.

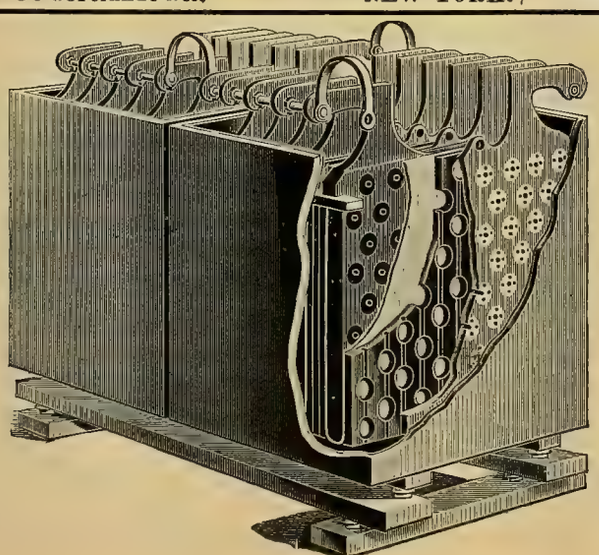
CEILING,
FLOOR COLUMN,
COUNTER COLUMN
FANS
FOR DIRECT CURRENT.



NEW TYPE
DESK PROPELLER FANS
FOR DIRECT
OR
ALTERNATING CURRENT.

Send for Catalogue containing cut of our new "ELECTROLIER" FAN.

DIEHL & COMPANY, 385 Broadway, New York City.



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Cells from 10 to 5,000 amp. hours Capacity.

Central Station and Traction Cells a Specialty.

BATTERIES FOR ISOLATED LIGHTING AND POWER PLANTS.

Catalogue gives FACTS and FIGURES.

THE ELECTRIC STORAGE BATTERY CO.,
Drexel Building,
PHILADELPHIA, PA.

Something New.

THE ALLEN SOLDERING STICK,

A Substitute for Resin, Acids and Soldering Salts.

ALWAYS READY FOR USE.

Makes a joint that will not corrode or in any way affect the surrounding insulation, in less time than it can be made in any other way.

Saves more than its cost in no time.
Cheaper than Acids or Salts.
No Waste—No Breakage.

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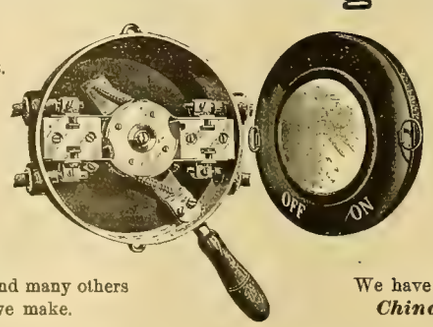

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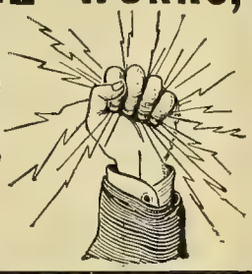

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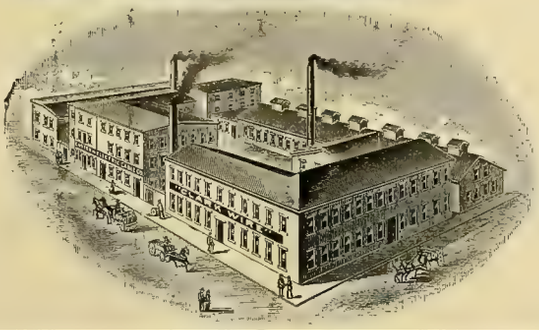

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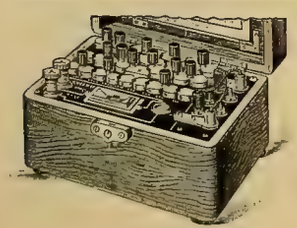

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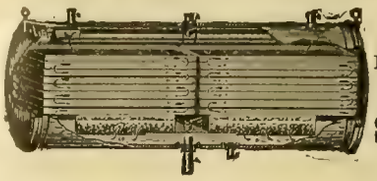

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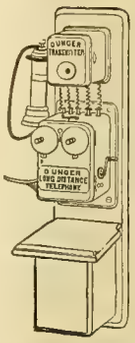

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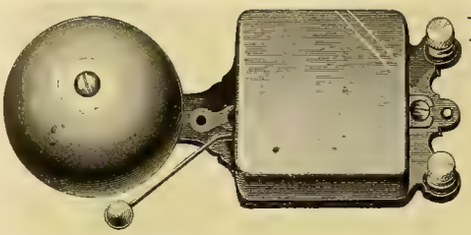

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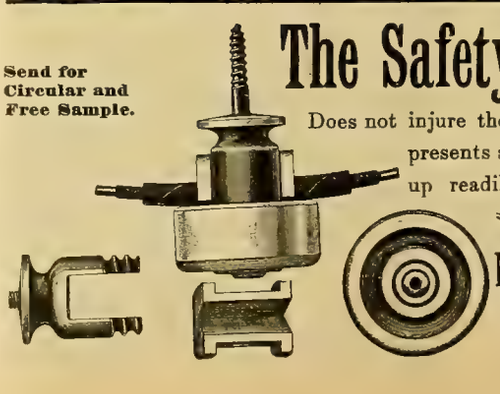

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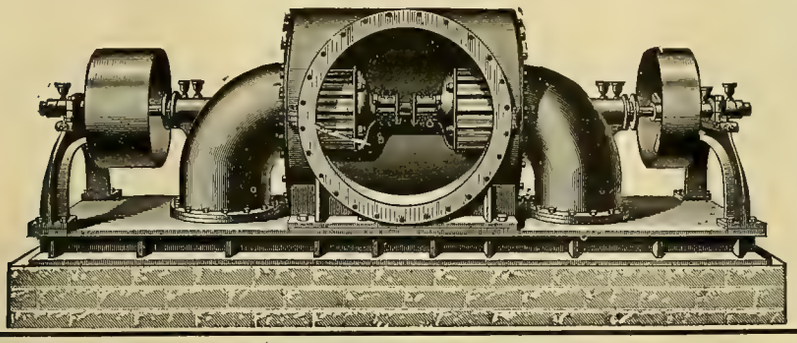

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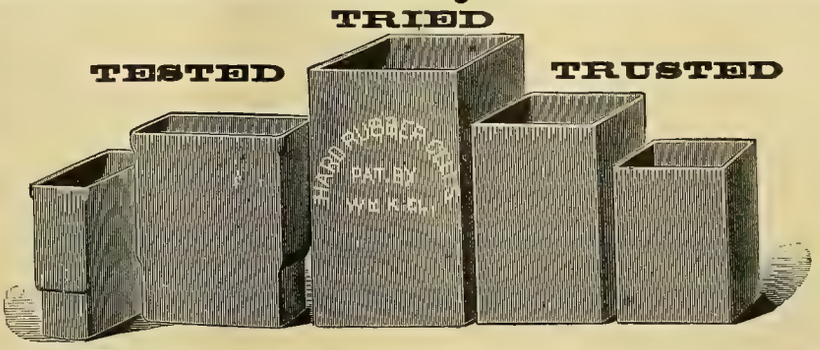

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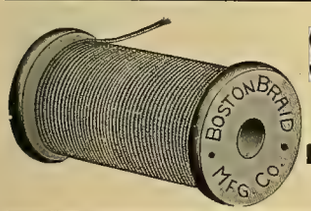

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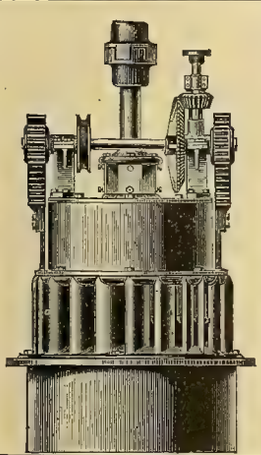

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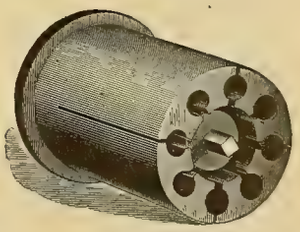

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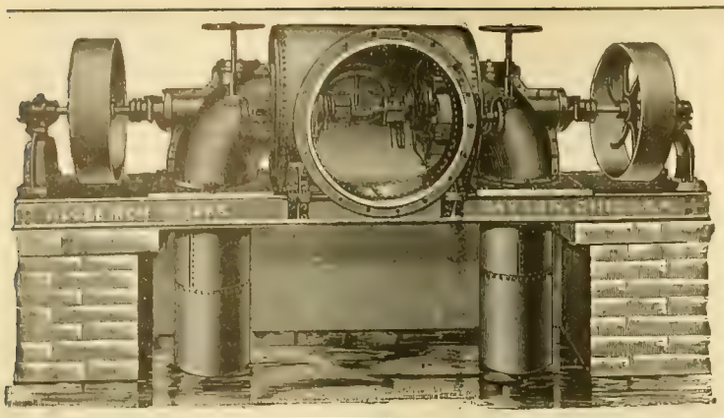

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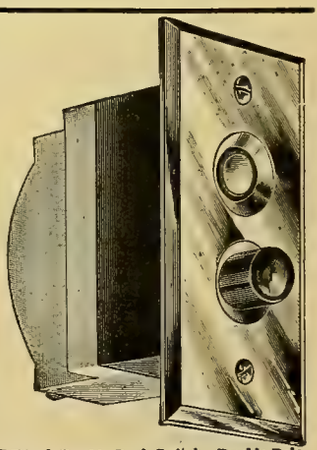

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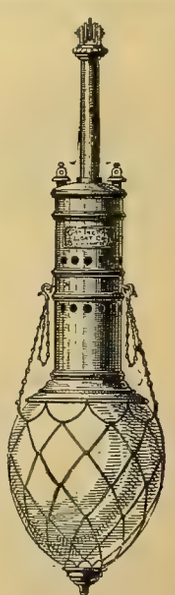

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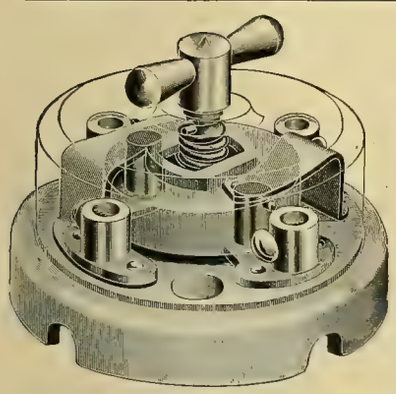

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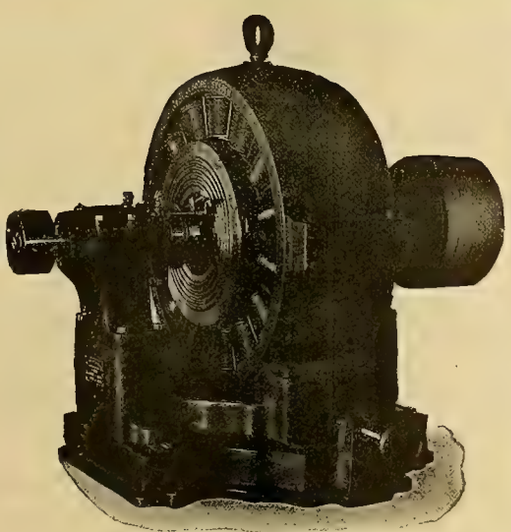

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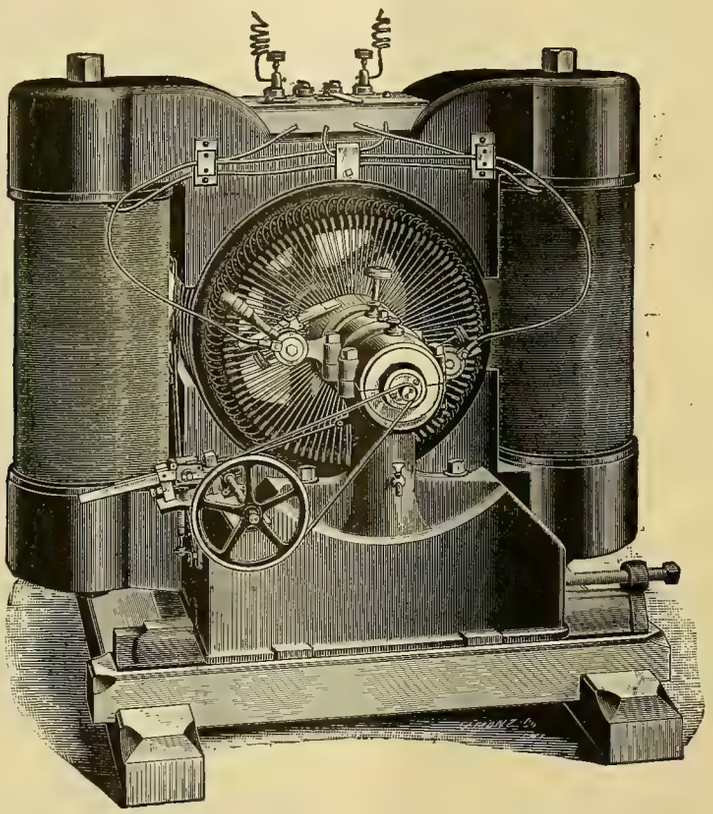

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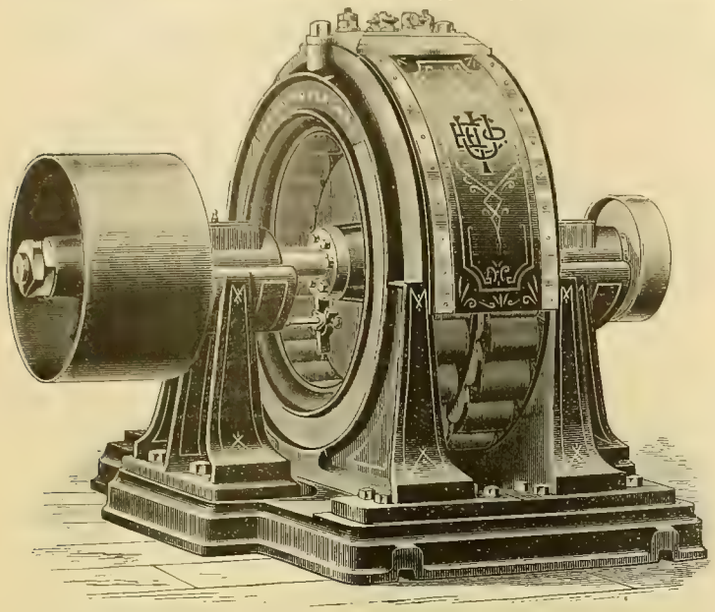

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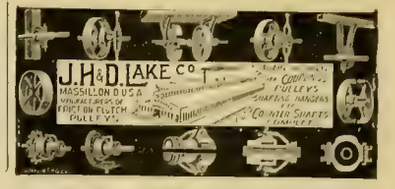

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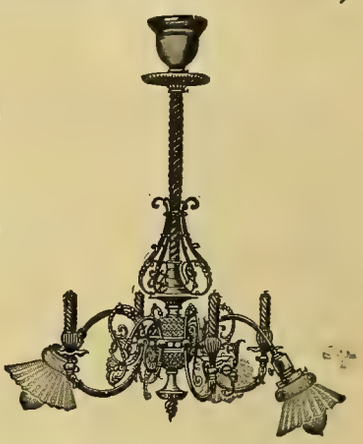

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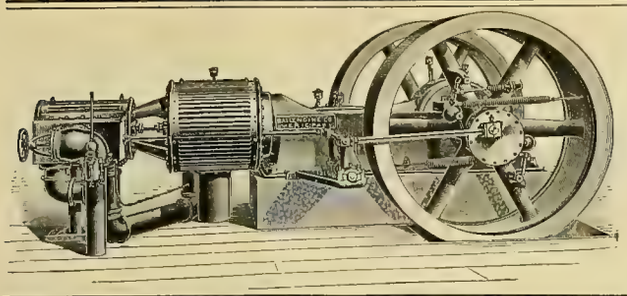

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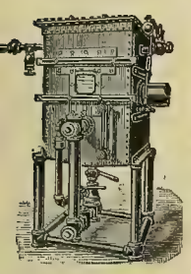

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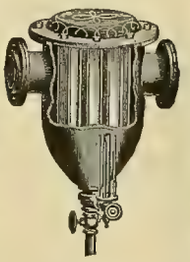

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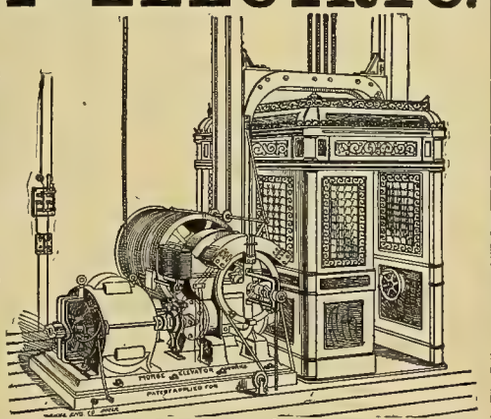

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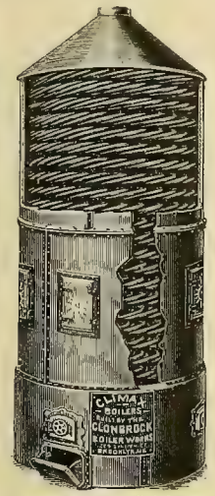

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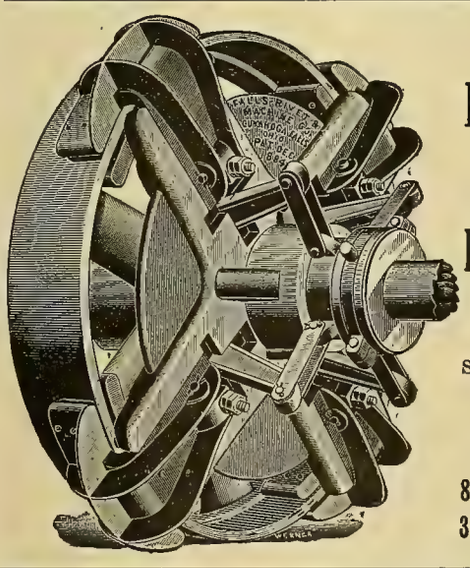

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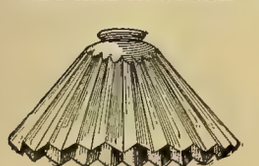
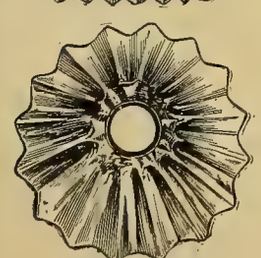
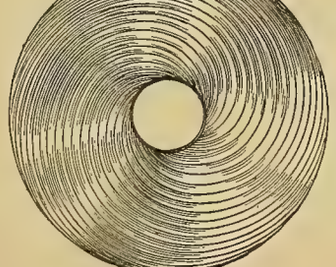




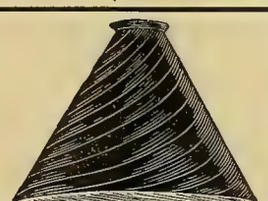
Radial Fluted.

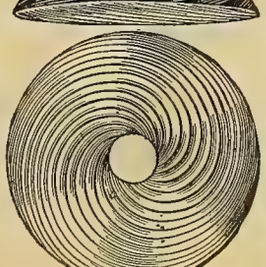
			PER DOZEN
17 in. diameter,	2¼ in.	holder,	$ 9.00
8 " "	2¼ "	"	10.00
0 " "	2¼ "	"	12.00



Flat Spiral Corrugated.

			PER DOZEN
8 in. diameter,	2¼ in.	holder,	$ 8.00
10 " "	2¼ "	"	9.00





Deep Spiral Corrugated.

			PER DOZEN
7 in. diameter,	2¼ in.	holder,	$ 8.00
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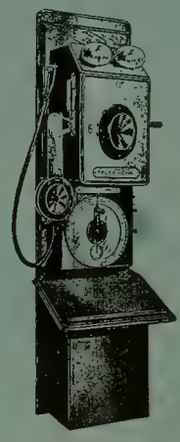

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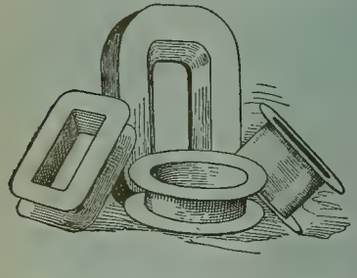

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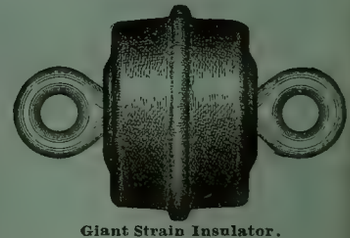

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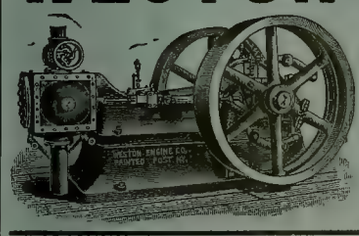

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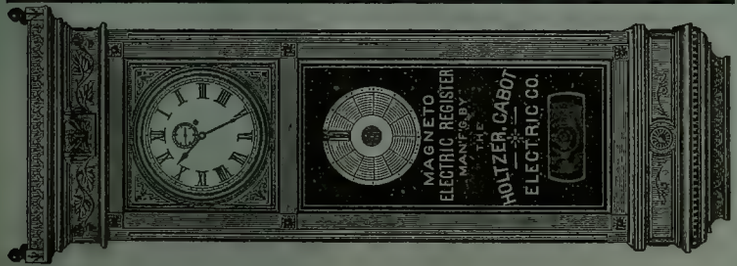

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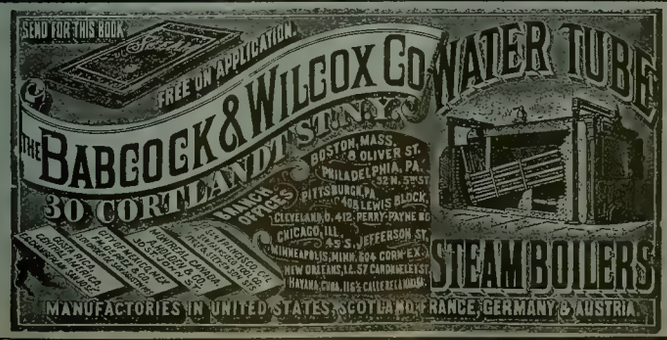

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Metropolitan Electric Co
Western Electric Co.

Car-Heaters, Electric.
Consolidated Car-Heating Co.

Clutches, Friction.
Falls Rivet & Machine Co.
Lake, J. H. & D. Co.
Link Belt Machinery Co.

Conduits.
Fibre Conduit Co., The.

Construction & Repairs.
Allen-Hussey Co.
Amstutz, N. S.
Andrews & Haschke.
C & C Electric Co.
Capitol Model & Mach. Wks
Comstock, Louis K.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co
Mather Electric Co.
Osburn, Harry G.
Pullman Electric Co.
Stone, O. M.
Wirt, Chas.

Contractors and Electric Light Plants.
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G
Arnold, B. J.
Ball, Wm. D
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Capitol Model & Mach. Wks.
Carter & Co., Geo.G.
Clark Electric Co.
Colburn Electric Mfg. Co.
Comstock, Louis K.
Consolidated Eng. Co.
Fort Wayne Electric Co.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Siemens & Halske Elec. Co.
Stone. O. M.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

Copper.
Law Battery Co.
Miamisburg Electric Co.

Copper Wires.
Adams. W. L. & Co.
American Electrical Works.
Ansonia Electric Co.
Bernard Co., The E. G.
Bishop Gutta Percha Co.
Bunnell & Co , J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Cross-Arms, Pins and Brackets.
Anderson, Albert & J. M.
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Taylor, Dee & Mack.

Cut-Outs and Switches.
Anderson, Albert & J. M.
Ansonia Electric Co.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Huebel & Manger.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Perkins Elec. Switch Mfg. Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Desk Lights.
McLeod. Ward & Co.

Dynamos.
Brush Electric Co.
C. & C. Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Fort Wayne Electric Co.
General Electric Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
Rose Elec. Light Supply Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Electric Railways.
Brush Electric Co
General Electric Co
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock, Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Merrill, Frederick L.
Monrath, Gustave.
Osborne Steam Eng. Co.
Osburn, Harry G.
Stone. O. M.
Wirt, Chas.

Electrical Instruments.
Anderson, Albert & J. M.
Ansonia Electric Co.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Queen & Company, Incorp.
Taylor, Dee & Mack.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.
Wirt, Chas.

Electrical Specialties.
Andrews & Haschke.
Capitol Model & Mach. Wks.
Electric Appliance Co.
Holtzer-Cabot Electric Co.
McLeod, Ward & Co.

Electric Slate.
Independent Electric Co.
Taylor, Dee & Mack.

Electroliers, etc.
Baggot, E.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.

Electro-Plating Mach'y.
Colburn Electric Mfg. Co.

Elevators, Electric.
Morse, Williams & Co.

Engines, Steam.
Ball & Wood Co., The.
Ball Engine Co.
Freeman Sons Mfg. Co.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Weston Engine Co.

Fan Outfits.
Diehl & Co.

Fibre.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

Fire Alarms.
Butler Hard Rubber Co.
Columbia Rubber Wks. Co.
Western Electric Co.

Fuse Wire.
Electric Appliance Co.
Independent Electric Co.

Gas Lighting, Electric.
Ansonia Electric Co.
Holtzer-Cabot Electric Co.

Gears.
Grant, Geo. B.

General Elec. Supplies.
Anderson, Albert & J. M.
Ansonia Electric Co.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Central Electric Co.
Colburn Electric Mfg. Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Law Battery Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
McLeod, Ward & Co.
Queen & Co., Incorp.
Sioux City Elec. Supply Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason E. P. Mfg. Co.
Hemingray Glass Co.

Graphite Specialties.
Dixon Crucible Co., Jos.

Hard Rubber Goods.
Butler Hard Rubber Co.
Columbia Rubber Wks. Co.
Delaware Hard Fibre Co.
Newton Rubber Co.

Insulators and Insulating Materials.
Anderson, Albert & J. M.
Andrews & Haschke.
Ansonia Electric Co.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Columbia Rubber Wks. Co.
Cutter Elec. & Mfg. Co.
Delaware Hard Fibre Co.
Electric Appliance Co.
Empire China Works.
Fibre Conduit Co., The.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Moore, Alfred F.
Munsell & Co., Eugene.
McLeod, Ward & Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.
Vulcanized Fibre Co.
Western Elec. Supply Co.

Insulated Wires and Cables—Magnet Wire.
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co..J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent.
Am. Electric Mfg. Co.
Beacon Vacuum Pump & Electrical Co.
Bernstein Electric Co.
Buckeye Electric Co
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Lasell & Co., Edw.
Mather Electric Co.
Metropolitan Electric Co.
New York and Ohio Co.
New York Electric Co.
Royal Arc Electric Co.
Taylor, Dee & Mack.
Westinghouse Elec. & Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Wirt, Chas.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Link Belt Machinery Co.

Mica.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
General Electric Co
Gregory, Chas. E. Co
La Roche Electric Wks.
Mather Electric Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Westinghouse El. & Mfg. Co.

Paints.
Standard Paint Co.

Patents.
Stocking, E. B.

Phosphor Bronze.
Phosphor Bronze Sm.Co., Ltd.

Platinum.
Baker & Co.

Porcelain.
Empire China Works.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electric Appliance Co
Huebel & Manger.
Metropolitan Electric Co.

Rheostats.
General Electric Co.

Sal Ammoniac.
Innis & Co.
Klipstein, A. & Co.
Law Battery Co.
Hayden-Booker Mfg. Co.

Second-Hand Electrical Machinery.
Gregory, Chas. E. Co.
Rose Elec. Lt. Supply Co.

Silk Braid.
Boston Braid Mfg. Co.

Slate.
Independent Electric Co.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co. Incorp.
Whitney Elec. Instrument Co.

Steam Heating.
Webster & Co., Warren.

Steam Pumps.
Worthington, Henry R.

Storage Batteries.
Bradbury-Stone Elec. S. Co.
Electric Storage Battery Co.

Stoves, Electric.
Consolidated Car-Heating Co

Street Cars.
Brill, J. G. Co.

Tapes, Insulating.
American Electrical Works.
Ansonia Electric Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Paint Co.
Taylor, Dee & Mack.

Telegraph Apparatus.
Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

Telephones,
Columbia Rubber Wks. Co.
D'Unger Elec. Tel. Mfg. Co.
Harrison Int. Telephone Co
Lasell & Co., Edw.
Manhattan Elec. Sup. Co.
Western Electric Co.
Western Tel. Const. Co.

Transformers.
Hornberger Elec. Mfg. Co.
Stanley Electric Mfg. Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stilwell & Bierce Mfg. Co.

Universities.
Cor. School of Mechanics.
Correspondence School of Technology.
Institute of Technology.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.
Smith, S. Morgan.

Wire, Bare.
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co
National India Rubber Co
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.

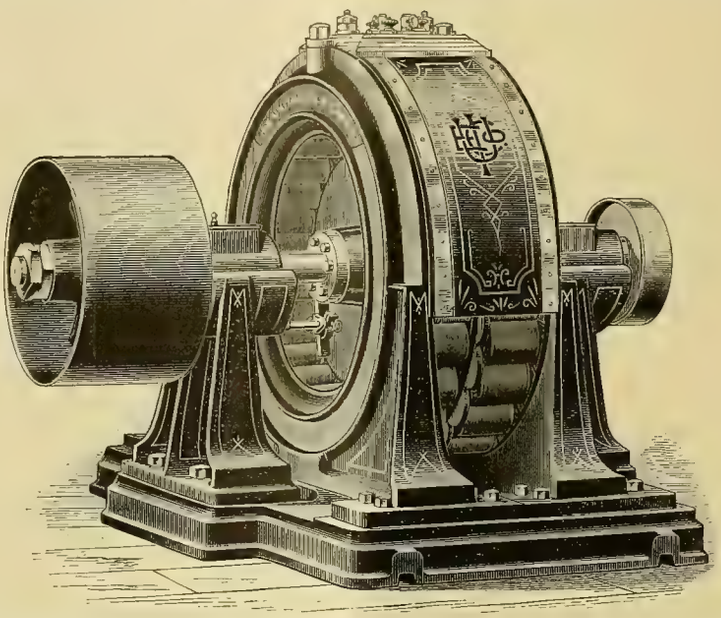
THE

United Electric Improvement Company,

838 DREXEL BUILDING, PHILADELPHIA,

Desire to correspond with responsible parties actively engaged in the sale of electric lighting apparatus in the following cities, viz.:

New York,
San Francisco,
Omaha,
Seattle,
New Orleans,
Cincinnati,
Boston,
Los Angeles,



St. Paul,
Galveston,
Atlanta,
Baltimore,
Montreal,
Salt Lake City,
Denver,
San Antonio,
Jacksonville.

TO THOSE DESIROUS OF TAKING UP THE SALE OF ALTERNATING CURRENT APPARATUS OF UNDOUBTED MERIT AN OPPORTUNITY IS OFFERED.

Don't make a Alternating Arc investigating

By Buying any Lamp before the

MON-ARC

Everything about it is of the very best. Brass Frame, Brass Shell, Brass Cap, Brass Rods. No tin or stovepipe iron. It combines unequaled simplicity with absence of all objectionable features heretofore present in alternating lamps. It is a **NON-STICKER** that central station men and lamp trimmers will be **STUCK** on because they don't have to **MONKEY** with it every few days, taking it down to clean and oil. Lamps for all systems. We guarantee every lamp. Write for prices.

THE F. P. LITTLE ELECTRICAL CONSTRUCTION & SUPPLY CO., Buffalo, N. Y.

G. M. ANCIER & CO., Agents for New England.
116 Bedford St., Boston, Mass.

McDOUGALL, LUCAS & CO., General Western Agents,
"The Rookery," Chicago, Ill.

1894. APRIL. 1894.

SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.
						7
1	2	3	4	5	6	
91	92	93	94	95	96	97
8	9	10	11	12	13	14
98	99	100	101	102	103	104
15	16	17	18	19	20	21
105	106	107	108	109	110	111
22	23	24	25	26	27	28
112	113	114	115	116	117	118
29	30					
119	120					

JANUARY

SU	M	TU	W	TH	F	SA
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

FEBRUARY

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

MARCH

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

APRIL

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

MAY

SU	M	TU	W	TH	F	SA
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JUNE

SU	M	TU	W	TH	F	SA
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

COMBINATION CALENDAR TABLET.
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JULY

SU	M	TU	W	TH	F	SA
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

AUGUST

SU	M	TU	W	TH	F	SA
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

SEPTEMBER

SU	M	TU	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

OCTOBER

SU	M	TU	W	TH	F	SA
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

NOVEMBER

SU	M	TU	W	TH	F	SA
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

DECEMBER

SU	M	TU	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

MOON'S PHASES.	NEW MOON.	FIRST QR.	FULL MOON.	LAST QR.
	5th	12th	19th	27th

DAYS IN APRIL

When You Should Send Us Your Order For

ALL ELECTRICAL SUPPLIES.

Send for Catalogue if you have not one already.

To Be Closed Out May 1st.

For the Next Month, Goods

AT COST.

Perhaps this list is what you want. Look at these Prices below. Everything else in proportion.

No. 1048 Fletcher Windlass	$2.75 each.
No. 1049 " "	3.25 "
No. 611 Cleveland Arc Cutouts	1.50 "
Edison 3 Light Plugs	.06 "
D-W Rosettes, Outside connections	.08 "
Keyless Sockets, Edison Base	.11 "
Key Wall Sockets, " "	.18 "
Shades—Ask for special circular	From 1.00 doz. up.
Standard Beattie Zincs	.20 each.
No. 611, 3 in. Bells, lots of 50	.30 "
Law Batteries	.55 "

Write for anything you want. Now is your chance to put in a stock at prices you never had before.

Our prices are ***SPOT CASH*** and this advertisement must be mentioned to obtain this greatly reduced price list. We positively cannot exchange any of these goods as they are all standard stock and we promise that they are in good condition when leaving our hands. Entire stock for sale in part or bulk, and stock always open for examination.

ANSONIA ELECTRIC CO.,

(FORMERLY THE ELECTRICAL SUPPLY CO.,)

RANDOLPH ST. AND MICHIGAN AVE.,
CHICAGO.

JAMES B. WALLER, Assignee.

We Want Western Business.

LA ROCHE ALTERNATORS.

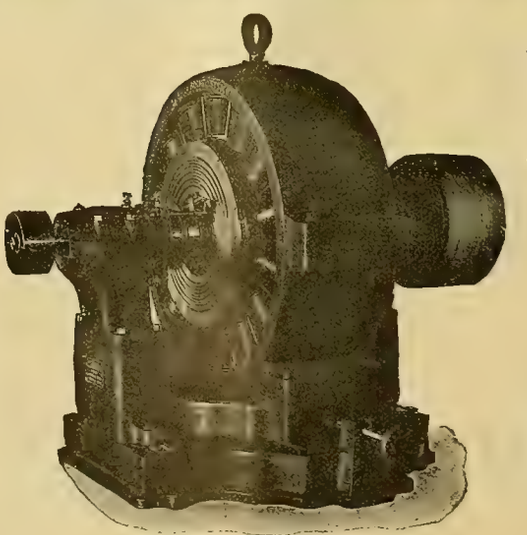
MANUFACTURED IN SIZES FROM

25 to 5,000 Lights,

SINGLE OR MULTIPHASE.

Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

La Roche Electric WORKS,

PHILADELPHIA, PA.

DISTRICT OFFICES:

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HOOD & OSBURN, 239 La Salle Street,
CHICAGO.

OWEN FORD, Rialto Building,
ST. LOUIS, MO.

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Engineers—Founders—Machinists,

General Office and Works, 39th St. and Stewart Ave.,
City Sales Office, 21 and 23 So. Jefferson St., CHICAGO, U. S. A.

DESIGNERS AND BUILDERS OF

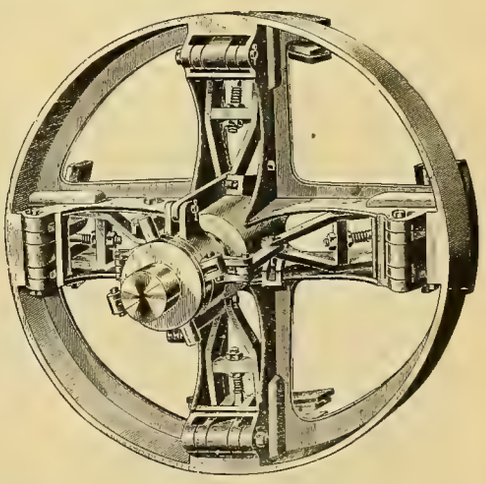
Machinery for Handling Coal and Ashes.

We have equipped the power plants of the following well-known firms with machinery for handling coal from cars, barges and wagons to boilers, and for taking ashes from under boilers to dump:

New York Edison Co., Elm and Pearl Streets, New York.
Pabst Light, Heat & Power Co., Milwaukee, Wis.
Milwaukee Street Railway Co., Milwaukee, Wis.
Cass Avenue and Fair Grounds Railway Co., St. Louis, Mo.
West End Street Railway Co., Boston, Mass.
New York Steam Heating Co , New York.
Washburn & Moen Mfg. Co., Waukegan, Ill.
Spreckles Sugar Refining Co., Philadelphia, Pa.
Illinois Steel Co., Joliet, Ill.
Illinois Steel Co., South Chicago, Ill.
Auditorium Hotel, Chicago.
P. Schoenhofen Brewing Co., Chicago.
Pabst Brewing Co., Milwaukee, Wis.
Franklin Sugar Refining Co., Philadelphia, Pa.
Anglo-American Packing & Provision Co., Union Stock Yards, Chicago, and many others.

SOLE MANUFACTURERS OF

The Ewart Guaranteed Friction Clutch,



Especially Designed for Heavy Duty at High Speed,
and Fully Guaranteed.

NOTE;—The Ewart is the ONLY CLUTCH which can be properly cast as a part of a driving pulley, rope sheave or gear, so that, when thrown out of engagement, the Clutch Mechanism is at rest, and accessible for adjustment, etc.

COMPLETE POWER TRANSMITTING MACHINERY

For Steam Generating Plants,

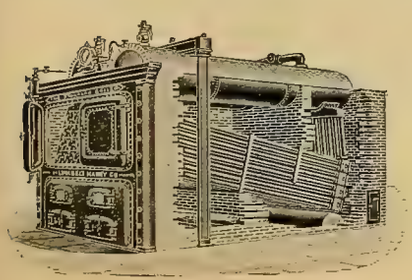
INCLUDING:

SHAFTING (IRON OR STEEL),
Up to 16 Inches in Diameter.

SHAFT BEARINGS, PULLEYS and GEARING,
Of any size, and of superior quality and design.

Rope Sheaves, Band and Fly Wheels.

Manilla Rope Power Transmissions.



The STANDARD Water Tube SAFETY Boiler.

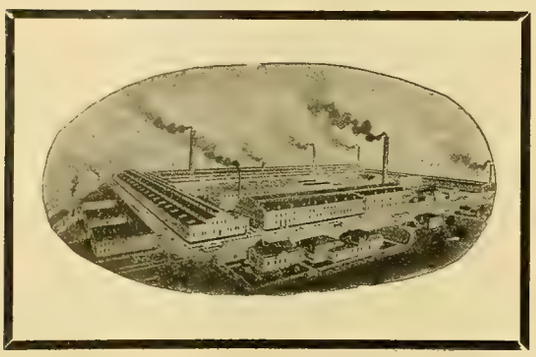
ABSOLUTE SAFETY WITH HIGHEST POSSIBLE ECONOMY.

Correspondence Solicited.

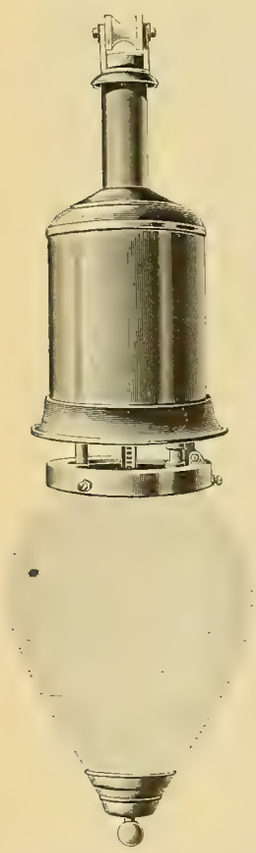
LINK-BELT.
Trade-Mark.

THE BRUSH ELECTRIC CO.,

CLEVELAND, O.



Arc Lighting Apparatus,
Incandescent Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Arc Lamps.



STANDARD "WARD" ARC LAMPS.

You have seen our special offer on 1,000 "Ward" lamps, direct current. Well, the sale is fairly under way. If you desire anything in this line, let us hear from you quickly. State full particulars and quantity that you wish figures on.

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Telephone Building, New York.

Established 1881.

Unity Building, Chicago.

PRICE REDUCED!

THE NEW EDITION OF

Prof. Silvanus P. Thompson's Book,

DNAYMO ELECTRIC MACHINERY,

NOW $6.00.

New Edition, Revised and Greatly Enlarged, Price $6.00.

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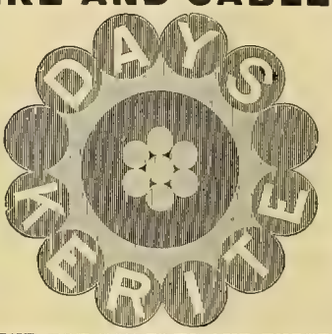

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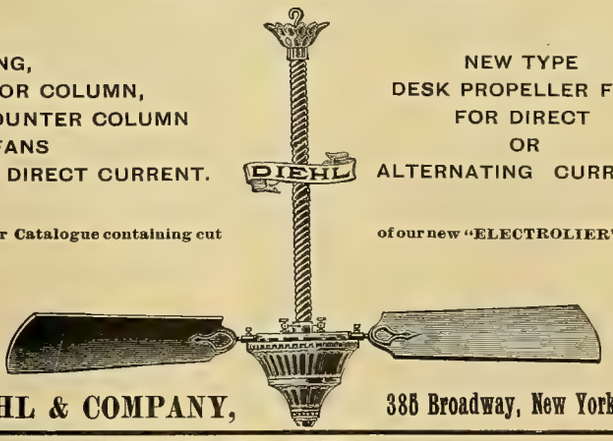

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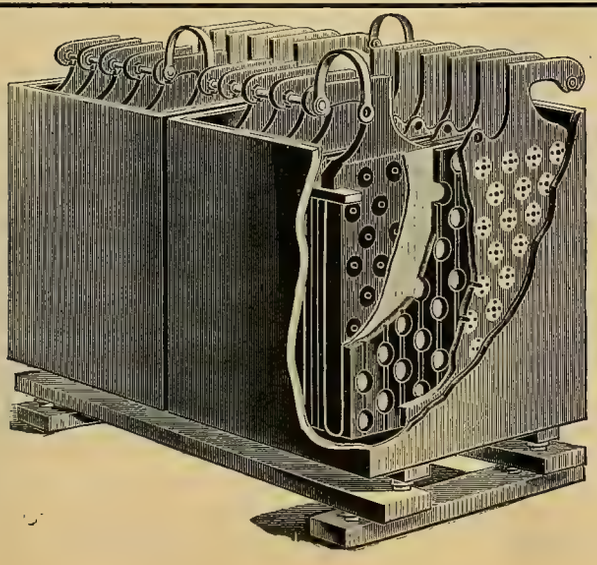

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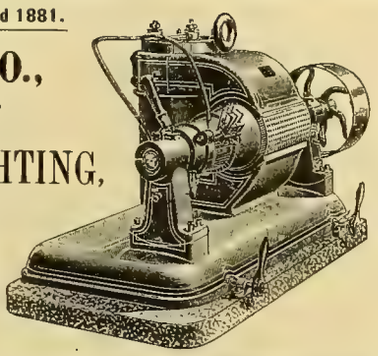

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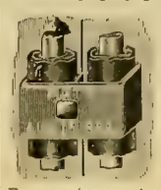

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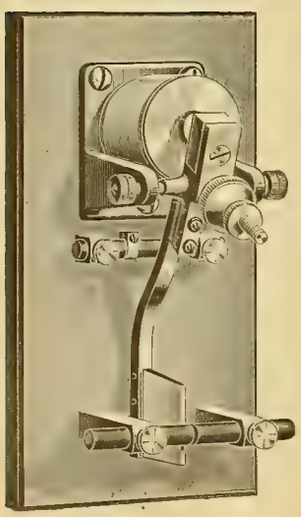

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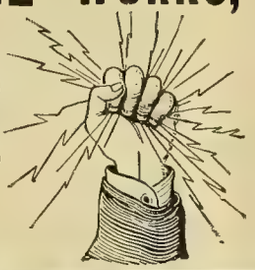

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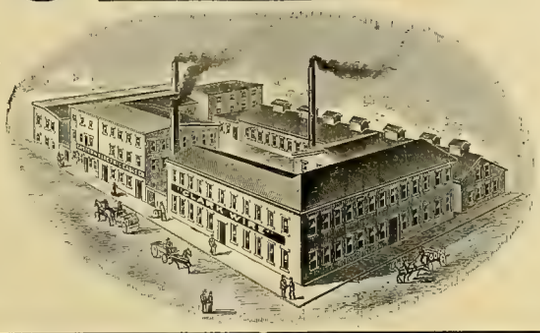

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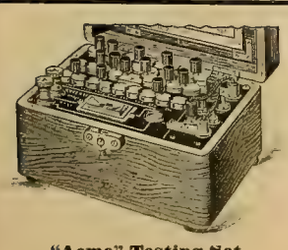

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Each 100 horse power with Converter and all Appliances. I have no use for such things and will sell them at less than half cost.

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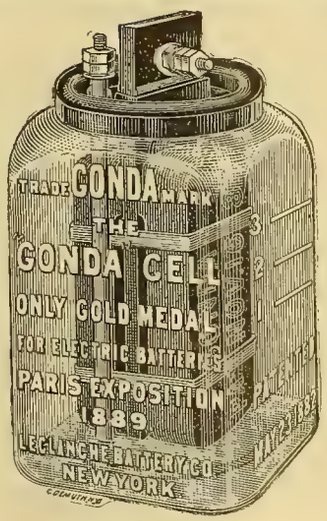

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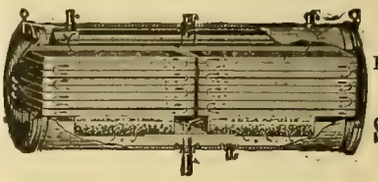

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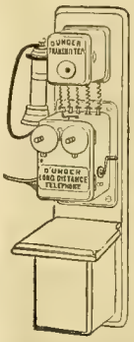

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Insulators, " **12.** " "
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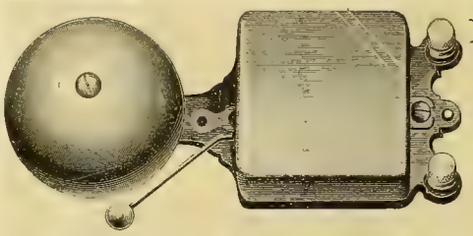

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Internal short circuiting or local action is eliminated.

Will not deteriorate when not doing work.
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Internal resistance, small, high and constant, E. M. F.

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ALL BATTERIES GUARANTEED. **SEND FOR CATALOGUE.**

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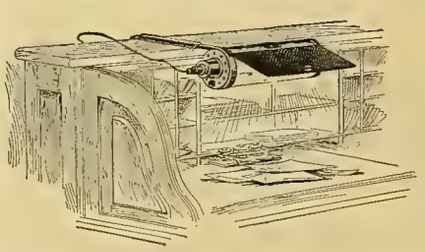

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Desk can be opened or closed without interfering with light.

By means of our rotary reflector, the desired quantity of light can be obtained.

Send us a sample order, mention style of socket required.

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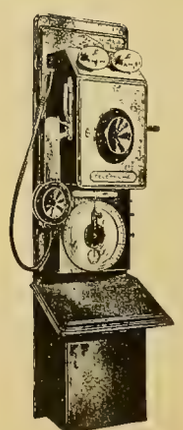

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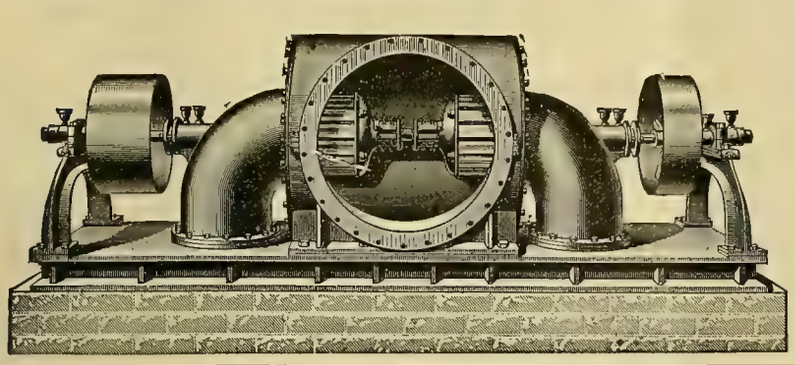

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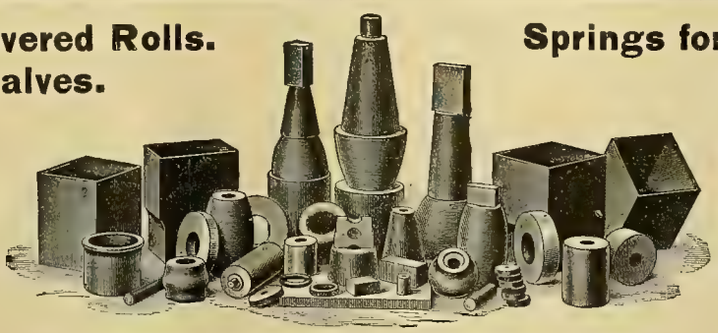

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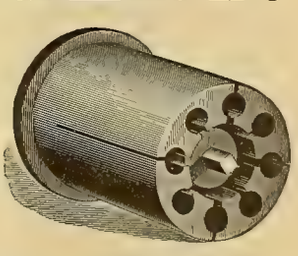

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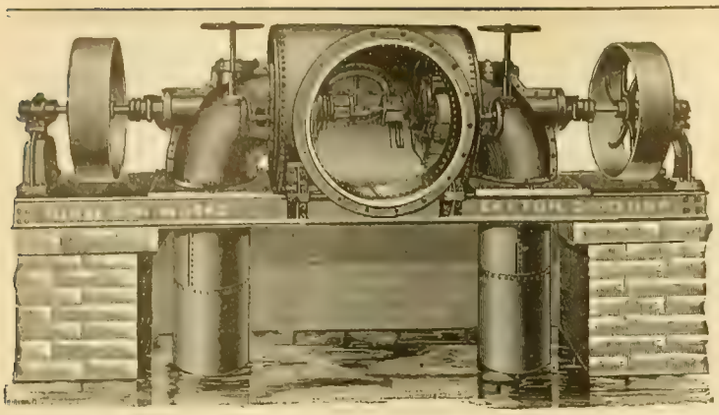

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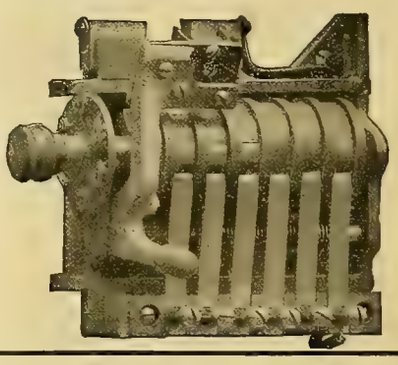

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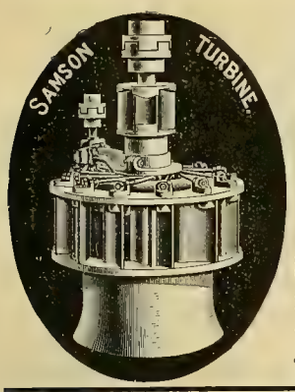

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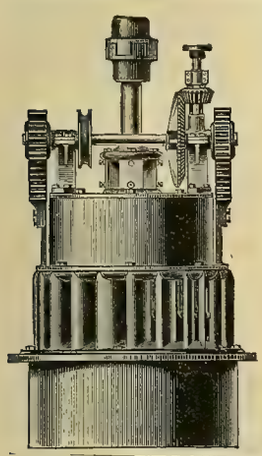

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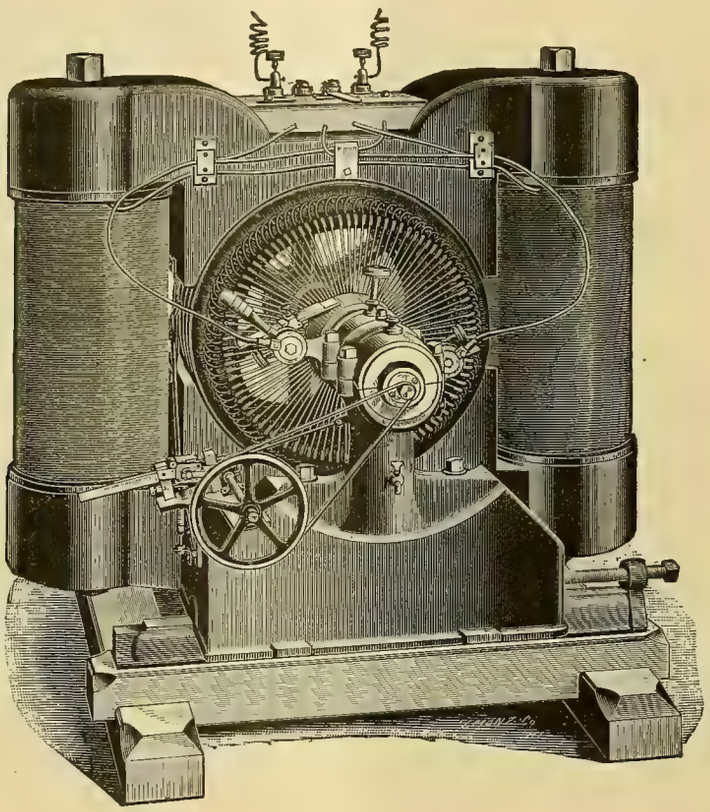

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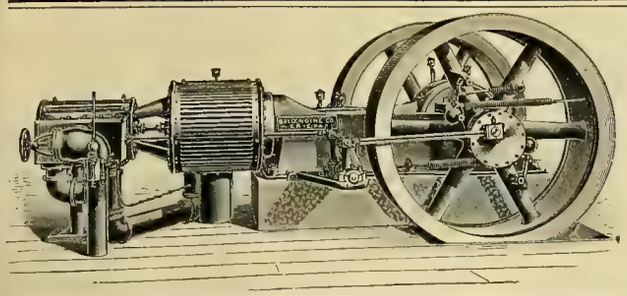

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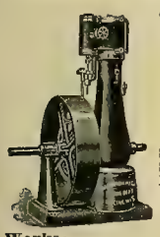

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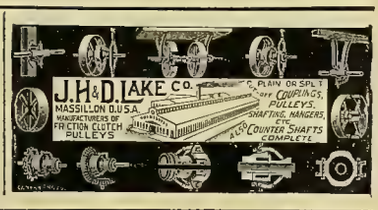

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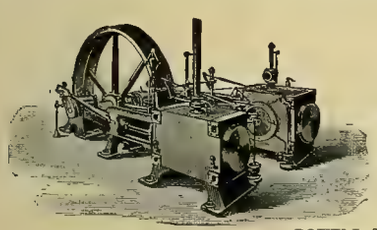

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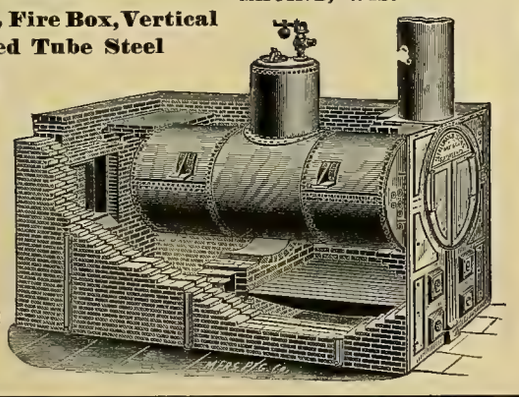

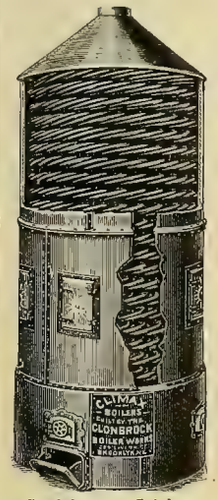

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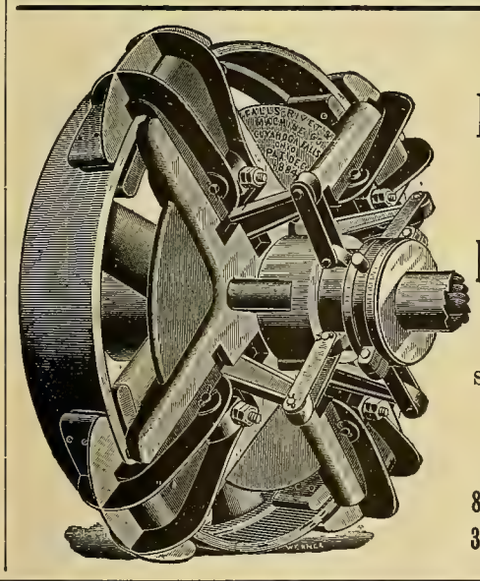

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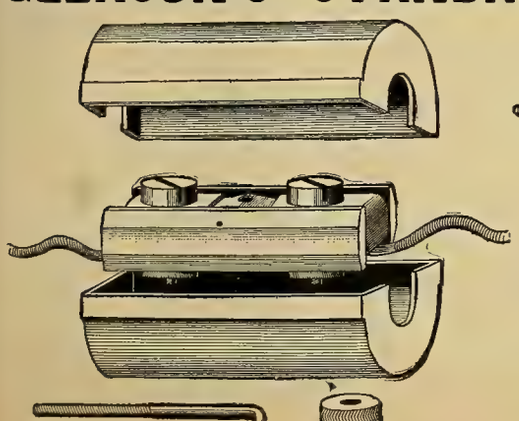
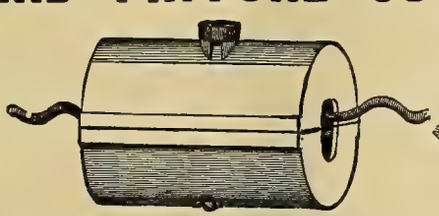


Enlarged cut showing construction of Gleason's Porcelain Lighting-Bug Cut-Out covered with porcelain.



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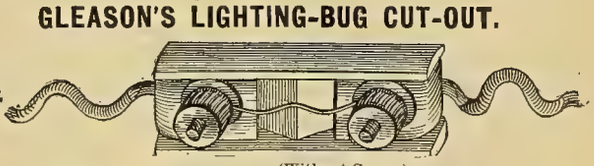

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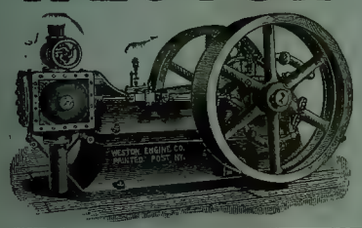

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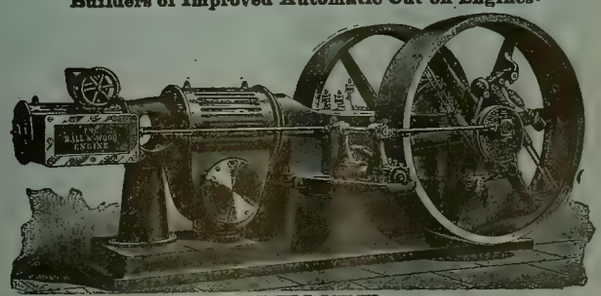

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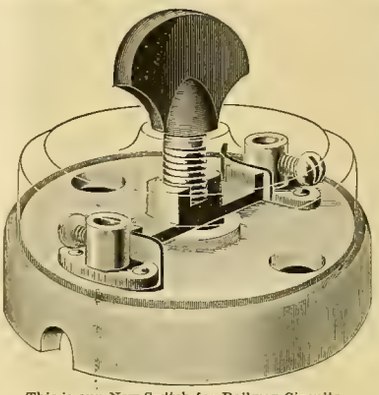

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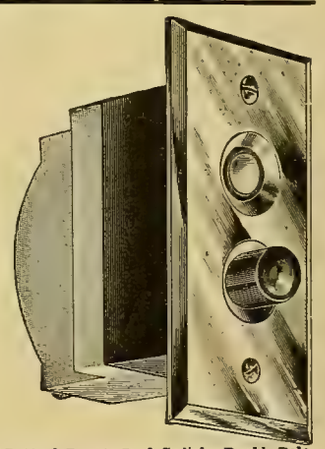

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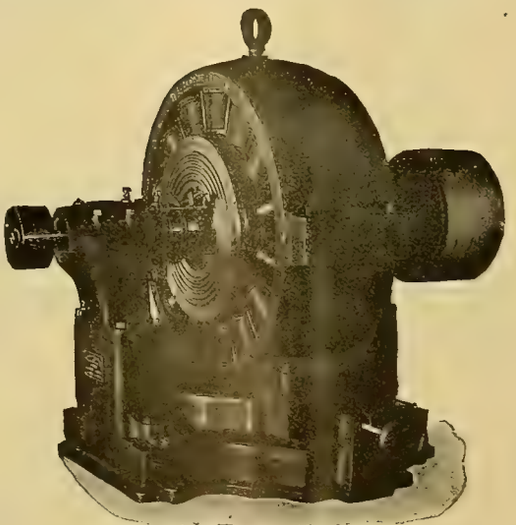

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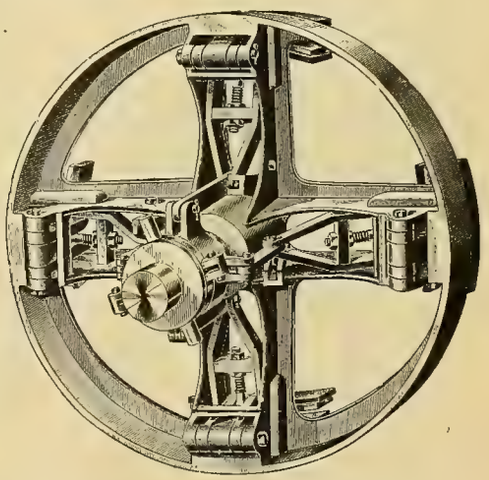

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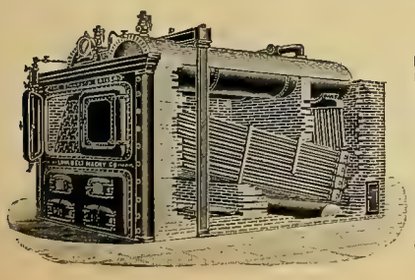

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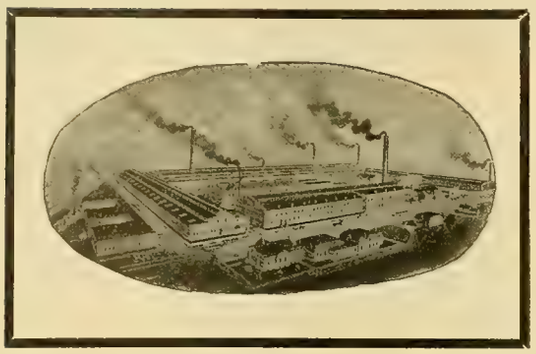

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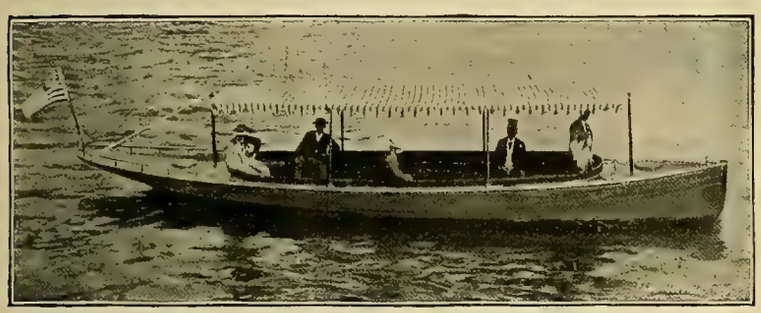

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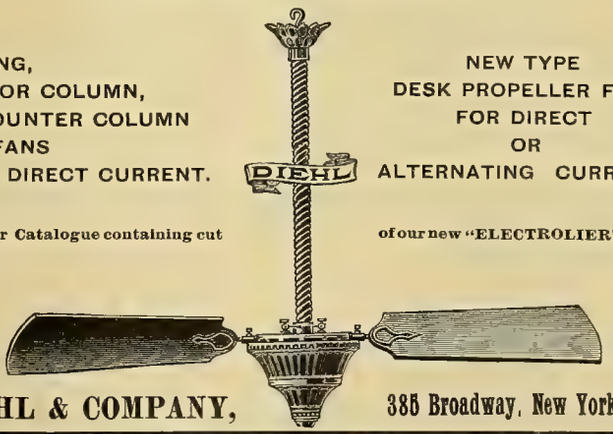

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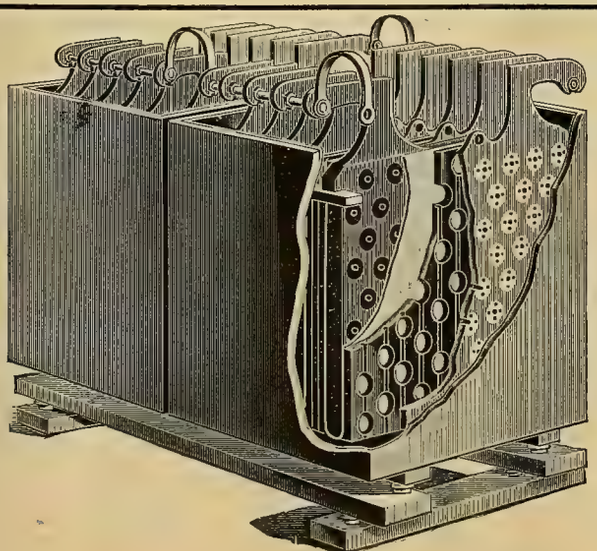

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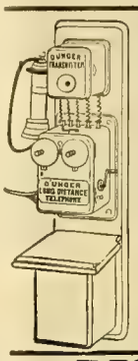

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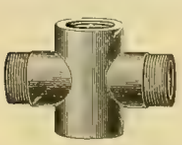

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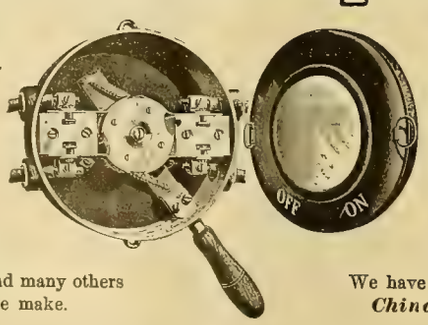

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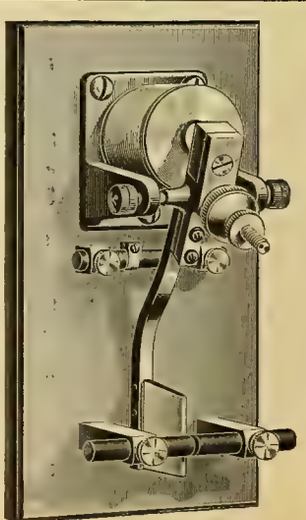

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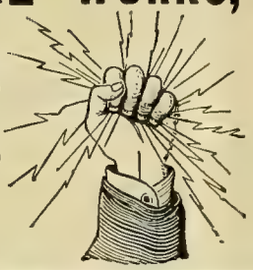

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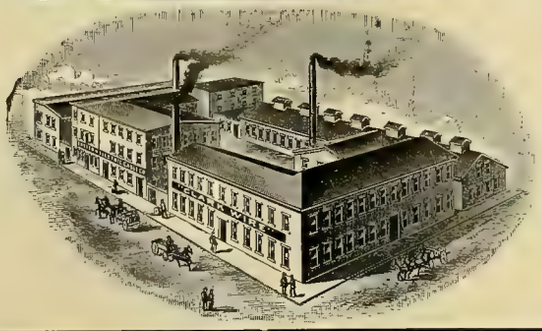

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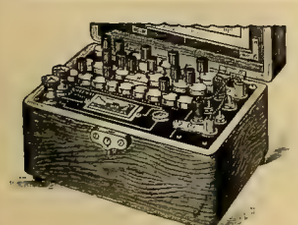

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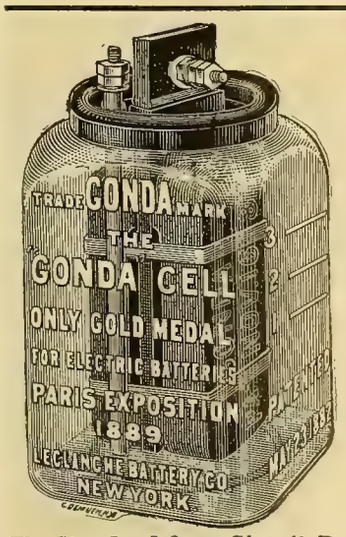

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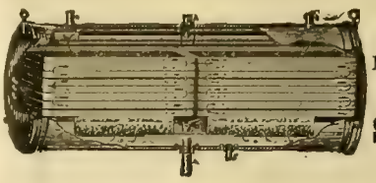

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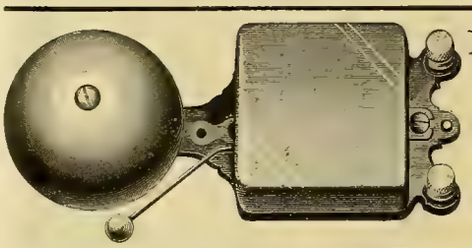

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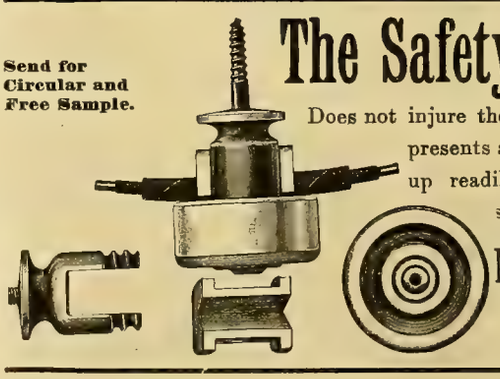

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Does not injure the insulation of the wire, presents a neat appearance, is put up readily without the use of screwdriver or other tool.

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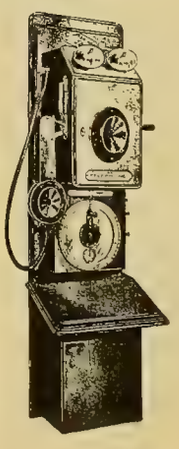

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WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE

Harrison International Telephone.

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

Prospectuses furnished by addressing the Company at their offices,

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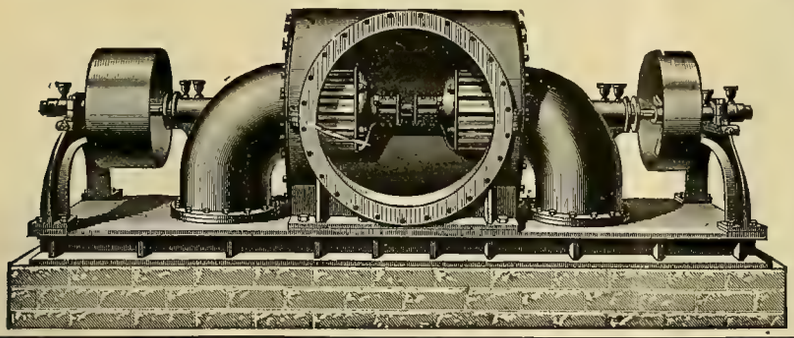

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

ACCEPTED.

We are puzzled to know what connection our artist could see between this cut and our line of business, but as we were never there ourselves, we defer to him. We think his thoughts ran about as follows:

We claim that for efficiency and durability our goods are unexcelled. This claim has been accepted not only by our own countrymen, but by the Asiatics and all those nations that branched out from that multitudinous throng that wandered from Asia, overspread and settled in Europe. Such being the case we **Propose** to you that you also, unknown friend, **Accept** our word and send us a trial order, feeling assured that in the end we shall have you for a steady customer. We have to offer you

The Celebrated Law Double Carbon Cell.
The Celebrated Law Carbon Porous Cup Cell.
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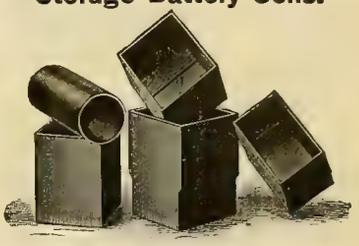
Storage Battery Cells.



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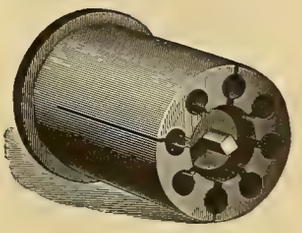

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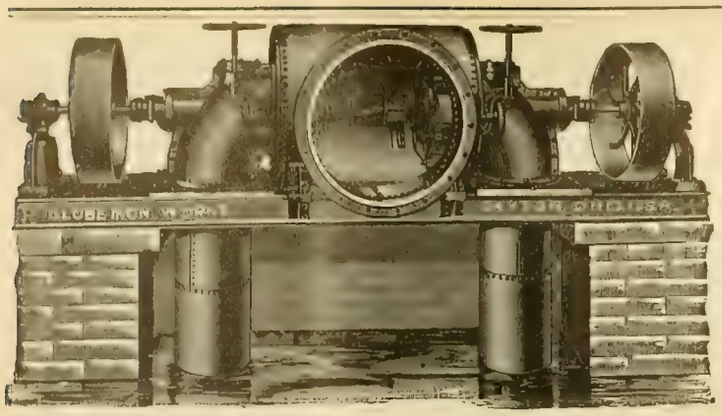

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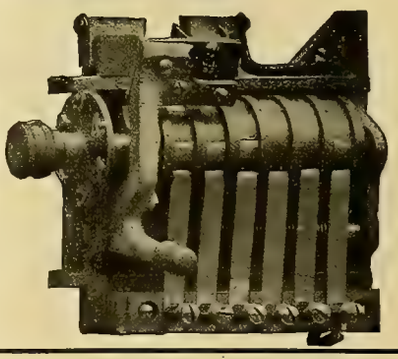

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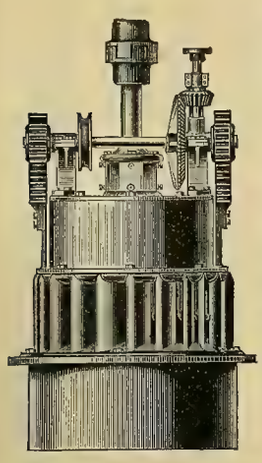

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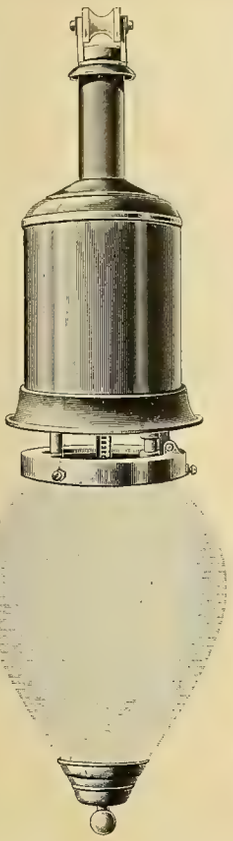

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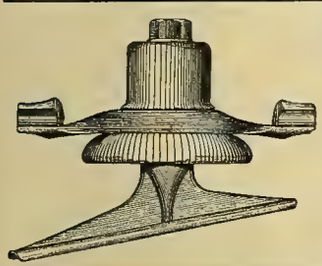

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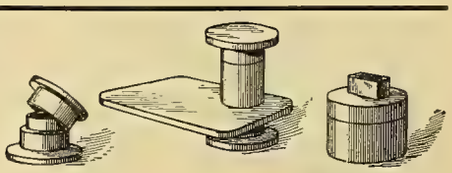

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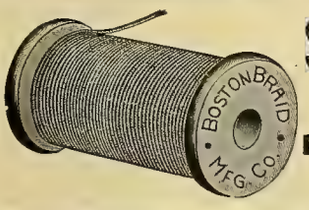

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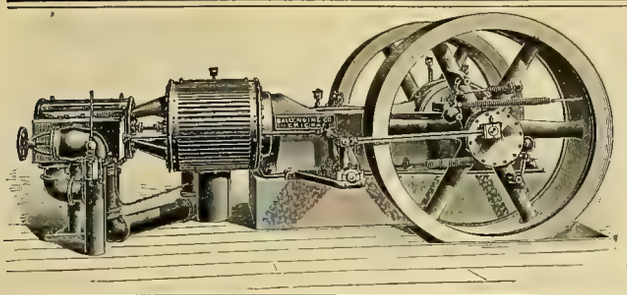

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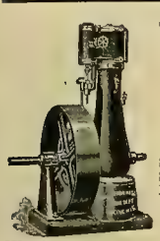

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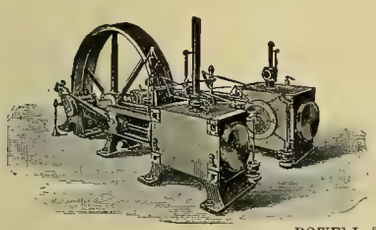

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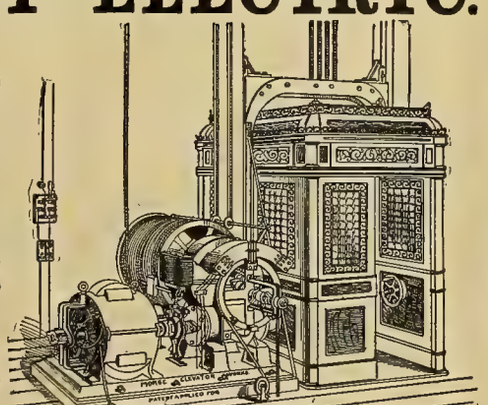

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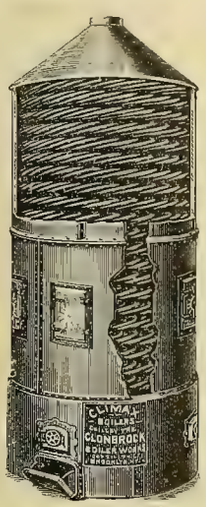

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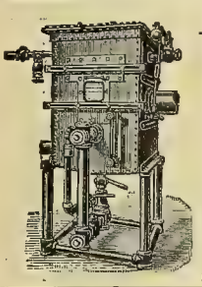

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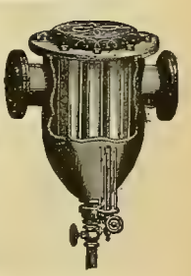

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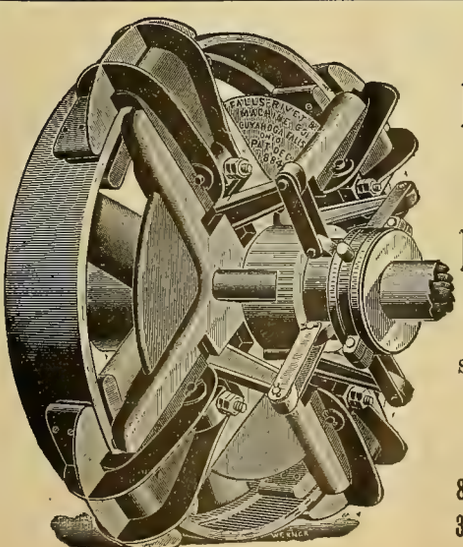

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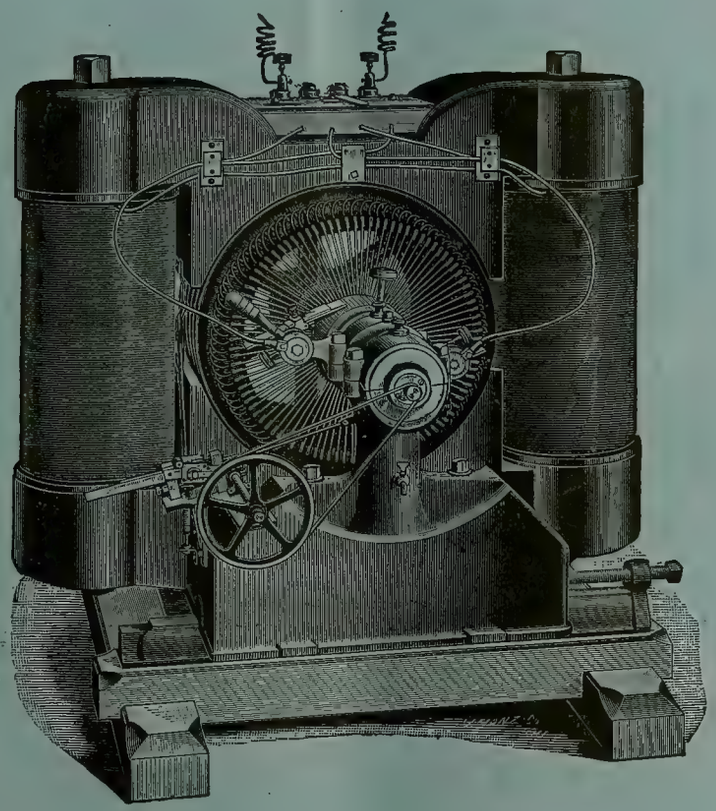

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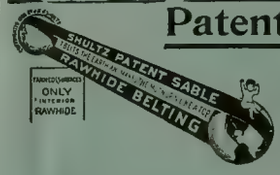

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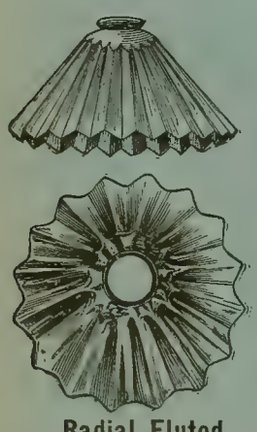

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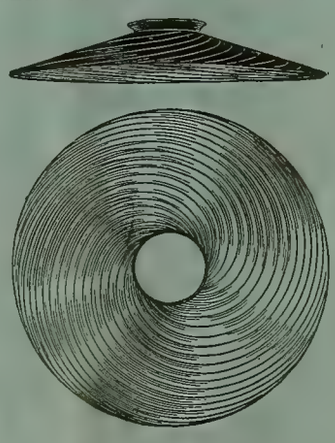

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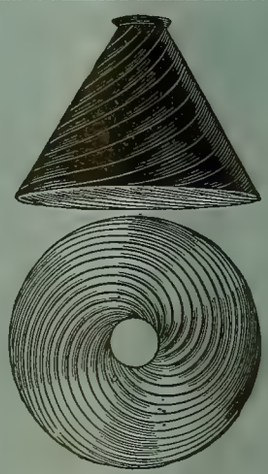

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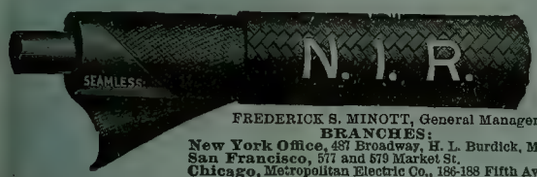

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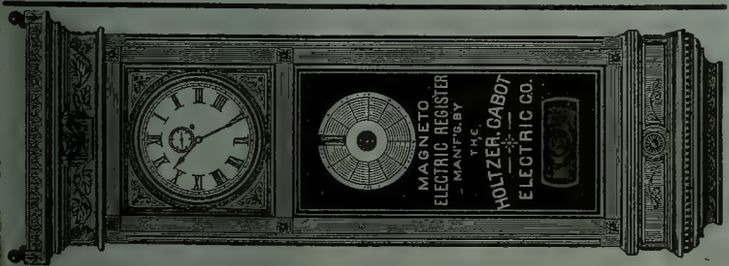

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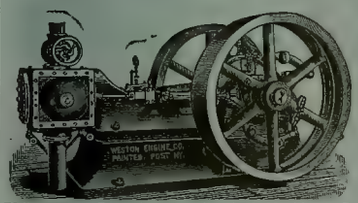

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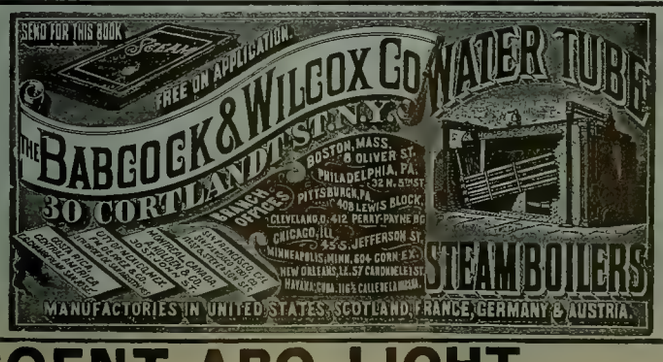

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Electric Storage Battery Co.

Adjusters, Lamp.
Dow Adjuster Co.

Annunciators.
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Arc Lamps.
C & C Electric Co.
Clark Electric Co,
Electric Appliance Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co.. The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Royal Arc Electric Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
Taylor, Dee & Mack.
Westinghouse El. & Mfg. Co.

Arc Light Cord.
Central Electric Co.
Electric Appliance Co.

Armature Winders.
Andrews & Haschke.
Stanwood M'f'g Co.

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Bradbury-Stone Elec. S. Co.
Bunnell & Co, J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Central Electric Co.
Columbia Rubber Wks. Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Law Battery Co.
Leclanche Battery Co., The.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Miamisburg Electric Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.
White, S. S. Dental Mfg. Co.

Bells.
Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Belting.
Columbia Rubber Wks. Co.
Shultz Belting Co.

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Babcock & Wilcox Co., The.
Clonbrock Steam Boiler Wks.
Freeman & Sons Mfg. Co.
Link Belt Machinery Co.
Racine Hardware Co.
Stirling Co., The.
Weston Engine Co.

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Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Cables (See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Carter & Co., Geo. G.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Hill, W. S. Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Taylor, Dee & Mack.
Western Electric Co.

Carbons, Points & Plates.
Central Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co
Western Electric Co.

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Consolidated Car-Heating Co.

Clutches, Friction.
Falls Rivet & Machine Co.
Lake, J. H. & D. Co.
Link Belt Machinery Co.

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Fibre Conduit Co., The.

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Allen-Hussey Co.
Amstutz, N. S.
Andrews & Haschke.
C & C Electric Co.
Capitol Model & Mach. Wks
Comstock, Louis K.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co
Mather Electric Co.
Osburn, Harry G.
Stone, O. M.
Wirt, Chas.

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Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Clark Electric Co.
Colburn Electric Mfg. Co.
Comstock, Louis K.
Consolidated Eng. Co.
Fort Wayne Electric Co.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Siemens & Halske Elec. Co.
Stone, O. M.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

Copper.
Law Battery Co.
Miamisburg Electric Co.

Copper Wires.
Adams, W. L. & Co.
American Electrical Works.
Bernard Co., The E. G.
Bishop Gutta Percha Co.
Bunnell & Co, J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

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Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Locke & Co., Fred M.
Metropolitan Electric Co.
Taylor, Dee & Mack.

Cut-Outs and Switches.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Carter & Co., Geo. G.
Central Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Huebel & Manger.
Little, F. P. Elec. C. & S. Co.
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Western Elec. Supply Co.

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Clark Electric Co.
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Fort Wayne Electric Co.
General Electric Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
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Standard Electric Co.
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Bryan, Wm. H.
Comstock, Louis K.
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Goltz & Sinclair.
Merrill, Frederick L.
Monrath, Gustave.
Osborne Steam Eng. Co.
Osburn, Harry G.
Stone, O. M.
Wirt, Chas.

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Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
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Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Queen & Company, Incorp.
Taylor, Dee & Mack.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.
Wirt, Chas.

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Cooke, E. D.
Electric Appliance Co.
Holtzer-Cabot Electric Co.

Electric Slate.
Independent Electric Co.
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Edwards, W. S. Mfg. Co
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Engines, Steam.
Ball & Wood Co., The.
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Butler Hard Rubber Co.
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Independent Electric Co.

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Holtzer-Cabot Electric Co.

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Anderson, Albert & J. M.
Ansonia Electric Co.
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Bryant Electric Co.
Bunnell & Co., J. H.
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Carter & Co., Geo. G.
Central Electric Co.
Colburn Electric Mfg. Co.
Cooke, E. D.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Law Battery Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Palmer Bros.
Queen & Co., Incorp.
Sioux City Elec. Supply Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

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Gleason E. P. Mfg. Co.
Hemingray Glass Co.

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Butler Hard Rubber Co.
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Delaware Hard Fibre Co.

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American Hard Fibre Co.
Anderson, Albert & J. M.
Andrews & Haschke.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Columbia Rubber Wks. Co.
Cutter Elec. & Mfg. Co.
Delaware Hard Fibre Co.
Electric Appliance Co.
Empire China Works.
Fibre Conduit Co., The.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co
Locke & Co., Fred M.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Moore, Alfred F.
Munsell & Co.. Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.
Vulcanized Fibre Co.
Western Elec. Supply Co.

Insulated Wires and Cables—Magnet Wire.
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co.. J. H.
Carter & Co., Geo. G.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Lamp Shades.
Cooke, E. D.

Lamps, Incandescent.
Am. Electric Mfg. Co.
Beacon Vacuum Pump & Electrical Co.
Bernstein Electric Co.
Buckeye Electric Co
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Lasell & Co., Edw.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
Royal Arc Electric Co.
Taylor, Dee & Mack.
Westinghouse Elec. & Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Wirt, Chas.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Link Belt Machinery Co.

Mica.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
General Electric Co
Gregory, Chas. E. Co
La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Westinghouse El. & Mfg. Co.

Paints.
Standard Paint Co.

Patents.
Stocking, E. B.

Phosphor Bronze.
Phosphor Bronze Sm. Co., Ltd

Platinum.
Baker & Co.

Poles.
Brownlee & Co.

Porcelain.
Empire China Works.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electric Appliance Co
Huebel & Manger.
Metropolitan Electric Co.

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General Electric Co.

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Queen & Co. Incorp.
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Steam Pumps.
Worthington, Henry R.

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Electric Storage Battery Co.

Stoves, Electric.
Consolidated Car-Heating Co

Street Cars.
Brill, J. G. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Paint Co.
Taylor, Dee & Mack.

Telegraph Apparatus.
Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

Telephones.
Columbia Rubber Wks. Co.
D'Unger Elec. Tel. Mfg. Co.
D'Unger Long Dist. Tel. Co.
Harrison Int. Telephone Co
Lasell & Co., Edw.
Manhattan Elec. Sup. Co.
Palmer Bros.
Western Electric Co.
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Transformers.
Hornberger Elec. Mfg. Co.
Stanley Electric Mfg. Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stilwell & Bierce Mfg. Co.

Universities.
Cor. School of Mechanics.
Correspondence School of Technology.
Institute of Technology.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.
Smith, S. Morgan.

Wire, Bare.
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co
Electric Appliance Co.
Independent Electric Co.
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You have seen our special offer on 1,000 "Ward" lamps, direct current. Well, the sale is fairly under way. If you desire anything in this line, let us hear from you quickly. State full particulars and quantity that you wish figures on.

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Telephone Building, New York. Established 1881. Unity Building, Chicago.

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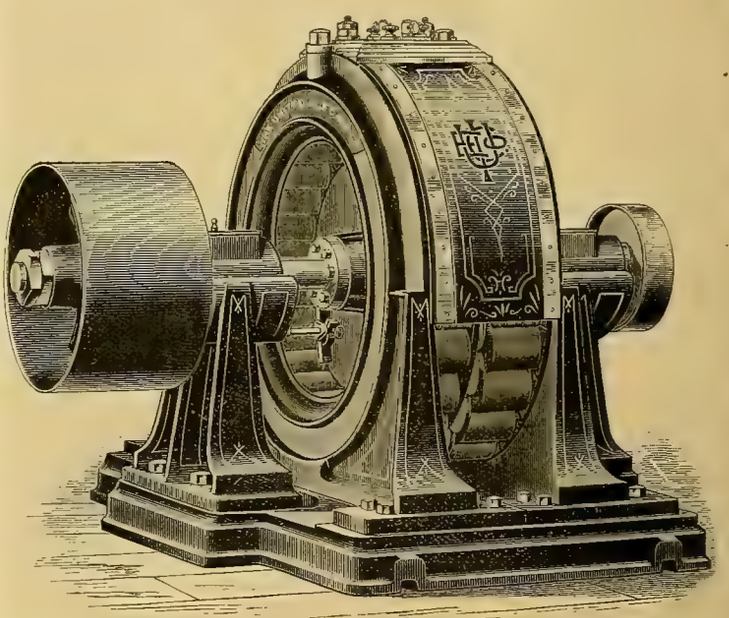
Desires to correspond with responsible parties actively engaged in the sale of electric lighting apparatus in the following cities, viz.:



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To those desirous of taking up the sale of Alternating Current Apparatus of undoubted merit, an opportunity is offered.

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OKONITE TRADE MARK

It is Accomplished!

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We now occupy the new premises; we have moved our *Lares* and *Penates* into this re-constructed edifice, and already begin to feel at home.

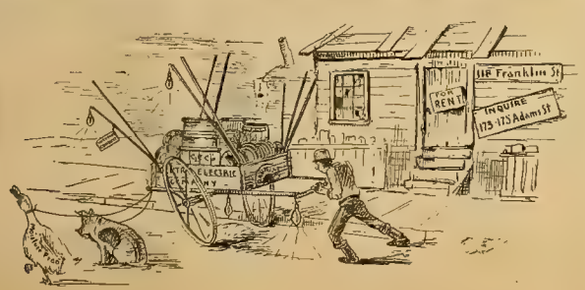
"CRAMPED."

For many months we have been seriously cramped for room. Our facilities for taking care of the increasing volume of trade has been very far from satisfactory; however, in this new domicile, we intend to have every thing that can be of value and assistance to the rapid and systematic ordering of work. We hope that the convenient and **perfectly arranged offices, capacious and well-lighted salesrooms, shipping rooms, and the immense storage area,** will not only result to our advantage, but to the good and pleasure of each one of our customers.

It may seem hackneyed, superfluous and commonplace, but we wish to add that we shall be delighted to see as many of our friends and patrons as can make it convenient to drop in on us at the new store.

"DELIGHTED."

We believe that we can truthfully say that no other Electrical Establishment in the United States can equal our present location in point of size, equipment, amount of stock carried, or in fact in any way approach us, **but come and judge for yourself.**



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CHICAGO.

WESTERN ELECTRIC COMPANY,

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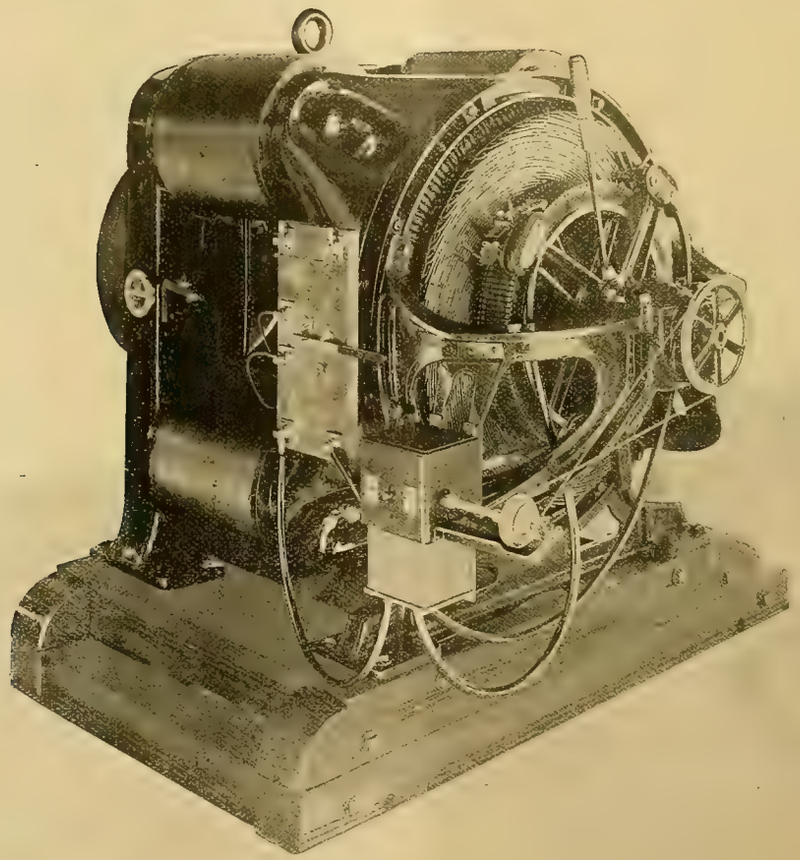
Electric Lighting Apparatus.

Slow Speed.

Carbon Brushes.



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New York Steam Heating Co, New York.
Washburn & Moen Mfg. Co., Waukegan, Ill.
Spreckles Sugar Refining Co., Philadelphia, Pa.
Illinois Steel Co., Joliet, Ill.
Illinois Steel Co., South Chicago, Ill.
Auditorium Hotel, Chicago.
P. Schoenhofen Brewing Co., Chicago.
Pabst Brewing Co., Milwaukee, Wis.
Franklin Sugar Refining Co., Philadelphia, Pa.
Anglo-American Packing & Provision Co., Union Stock Yards, Chicago, and many others.

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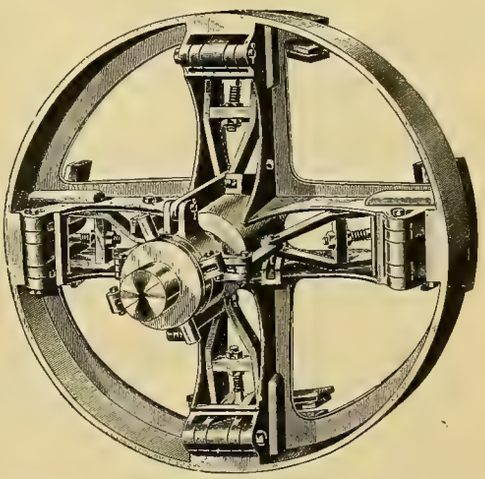

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SHAFT BEARINGS, PULLEYS and GEARING,
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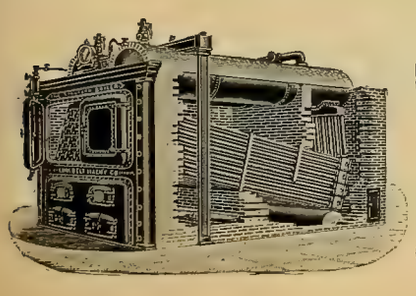

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ABSOLUTE SAFETY WITH HIGHEST POSSIBLE ECONOMY.

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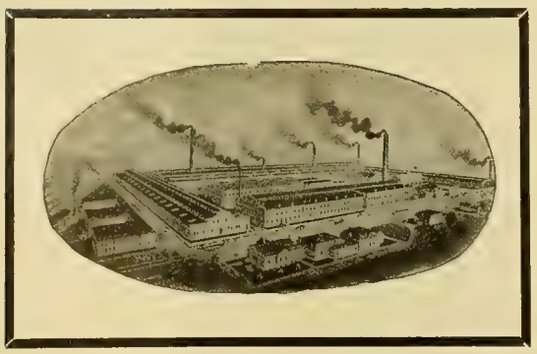

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Arc Lamps.

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which will cost no more than single phase. You can then operate lights as economically and as satisfactorily as from single phase generators, and in addition use

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of lamps, who have not as yet tried our

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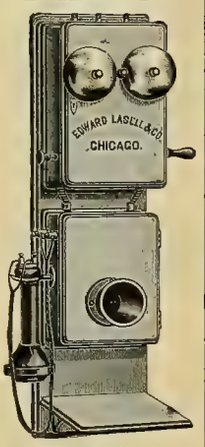
are doing themselves an injustice in not giving them one trial. Try it and see if what you may have thought of them is all right, or all wrong.



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Can be run in multiple from 50 or 100 volt secondary circuits by Spencer Economy Coils.

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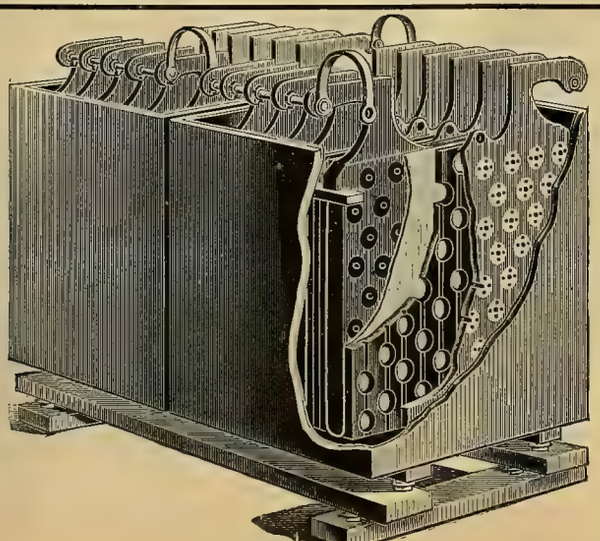

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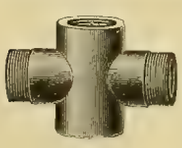

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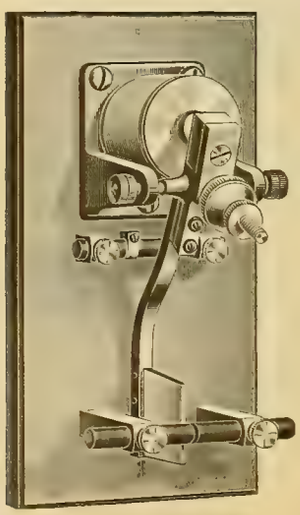

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It is absolutely positive, and limits the current following the lightning discharge to an amount that cannot do any possible injury.

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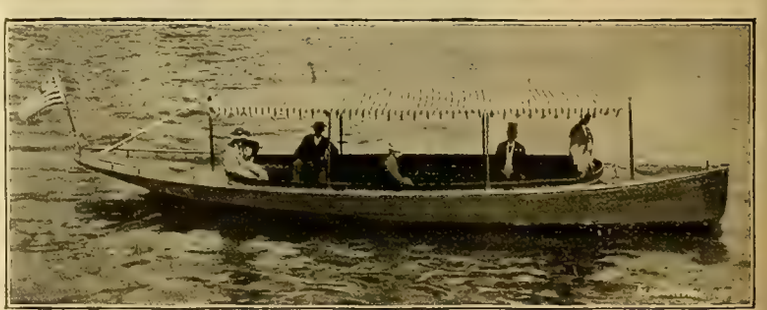
For all Classes of Work where Light and Power are Required.



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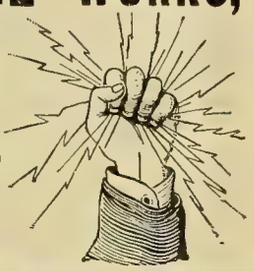
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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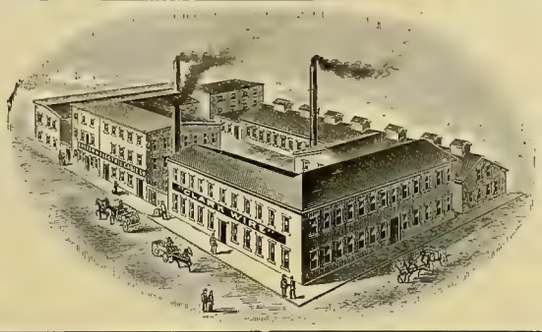

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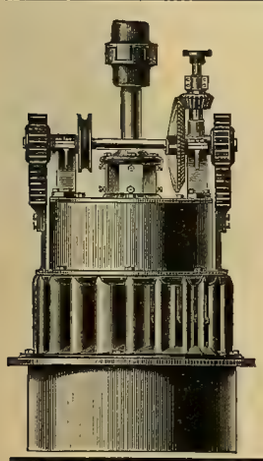

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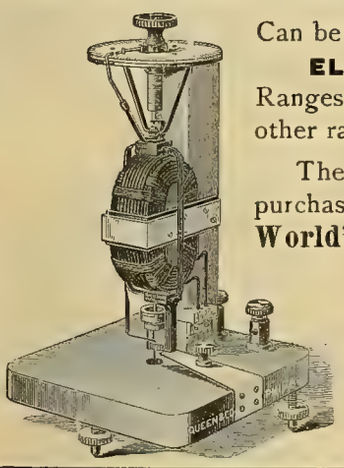

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Ranges from .2 to 500 amperes in stock; other ranges to order.

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WANTED.

Position by man having been manager of successful Electric Light Plant during construction and operation. Would take an interest in plant. Address

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BEWARE OF INFRINGING!

The D'Unger Long Distance Telephone (the "Far-Away Talker") can now be had for use in Telephone Exchanges on a small annual royalty, and **on no other terms**. It is constructed under numerous patents, especially **Patent No. 390,575**, granted Oct. 2, 1888, which is not only the **first**, but **the only undisputed and indisputable valid patent granted for an All-Carbon Multiple-Contact Microphonic Telephone Transmitter.** All all-carbon multiple-contact telephone transmitters built without or under patents granted since Oct. 2, 1888, are **infringements upon Patent No. 390,575**—a fact to be borne in mind by persons contemplating the use of Telephones.

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No D'Unger Telephones can be had for exchanges, except through me. R. D'UNGER.

Dynamos and Motors and PARTS OF SAME
ALL KINDS PRICES OF PARTS **TELEPHONES** ELECTRICAL SUPPLIES
SEND STAMP FOR CATALOGUE **PALMER BROS.** MANUS, CONN.

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SEND FOR CIRCULAR AND PRICES.

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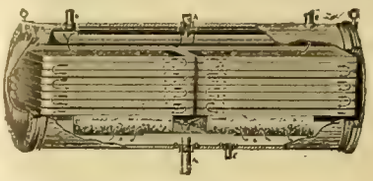
Stilwell's Patent Live Steam-Feed Water Purifier.



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Entirely prevents ***scale*** in Steam Boilers. Catalogue on application.

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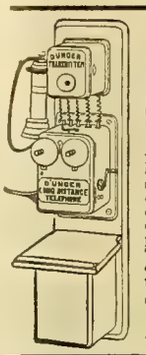

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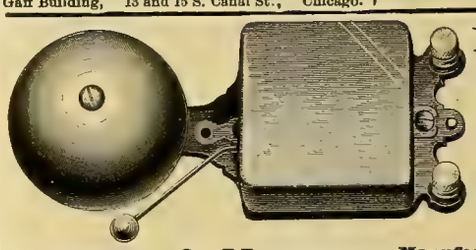

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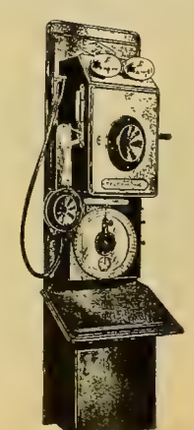

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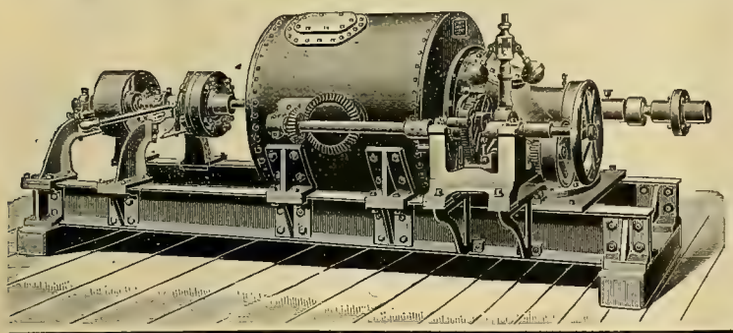

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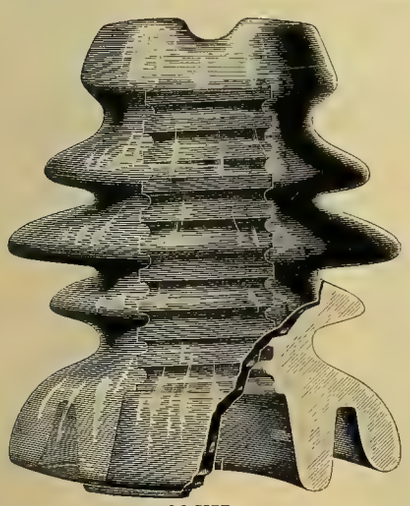

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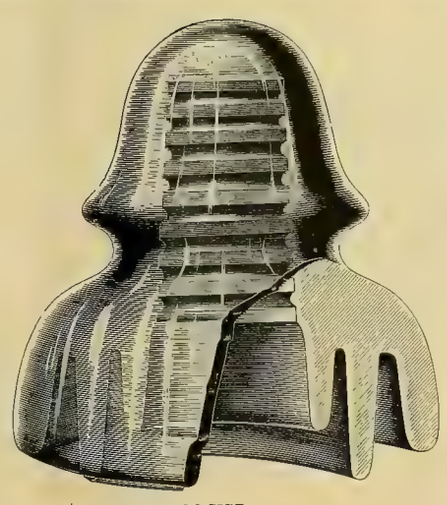

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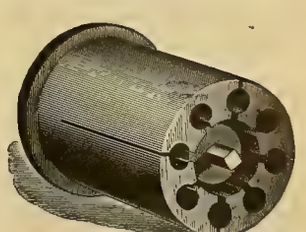

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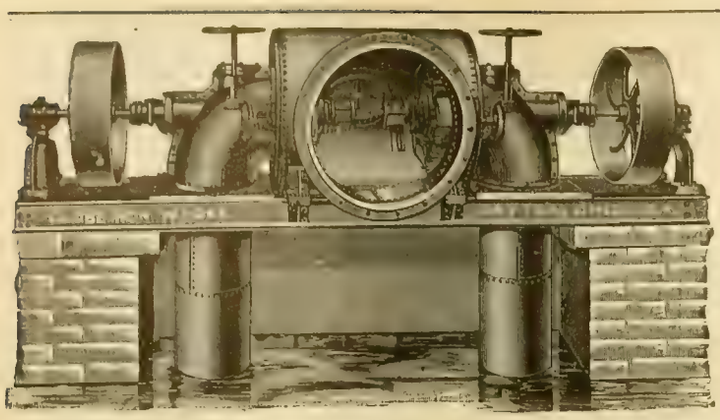

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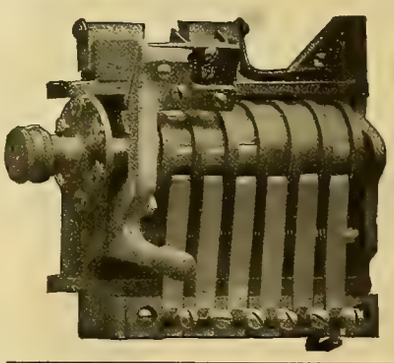

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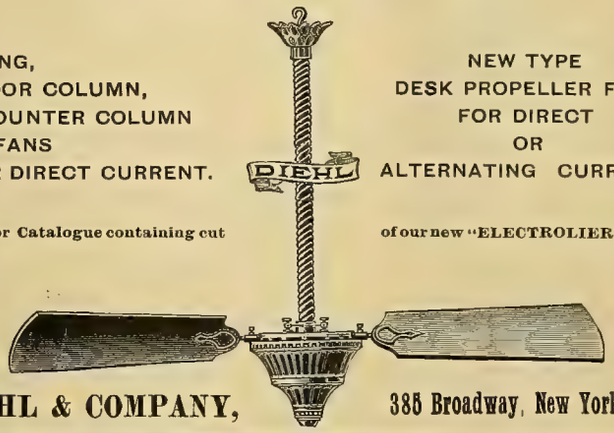

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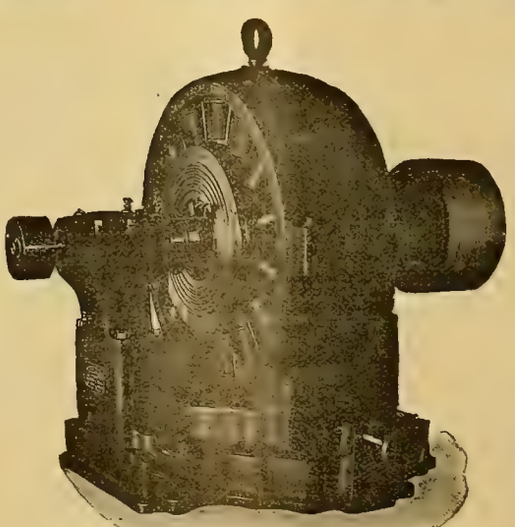

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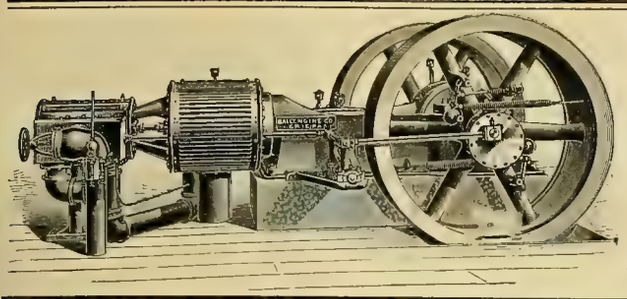

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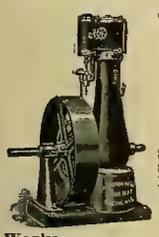

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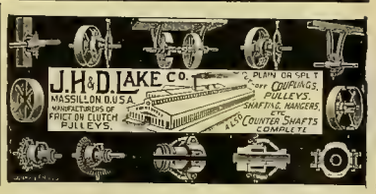

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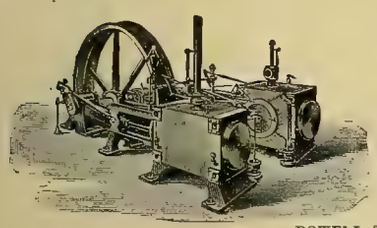

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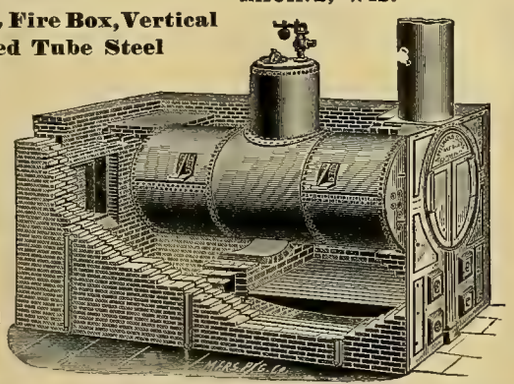

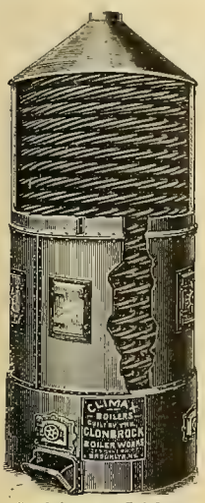

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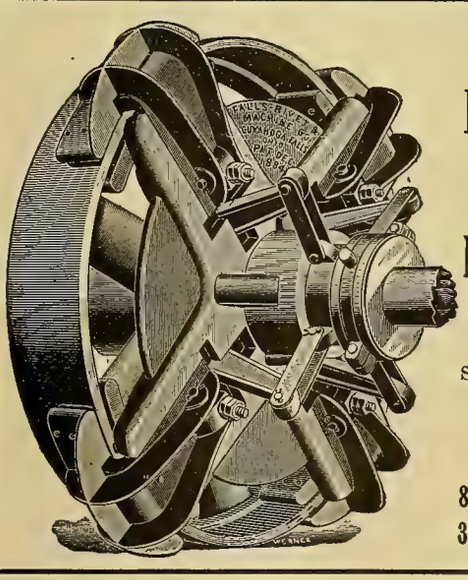

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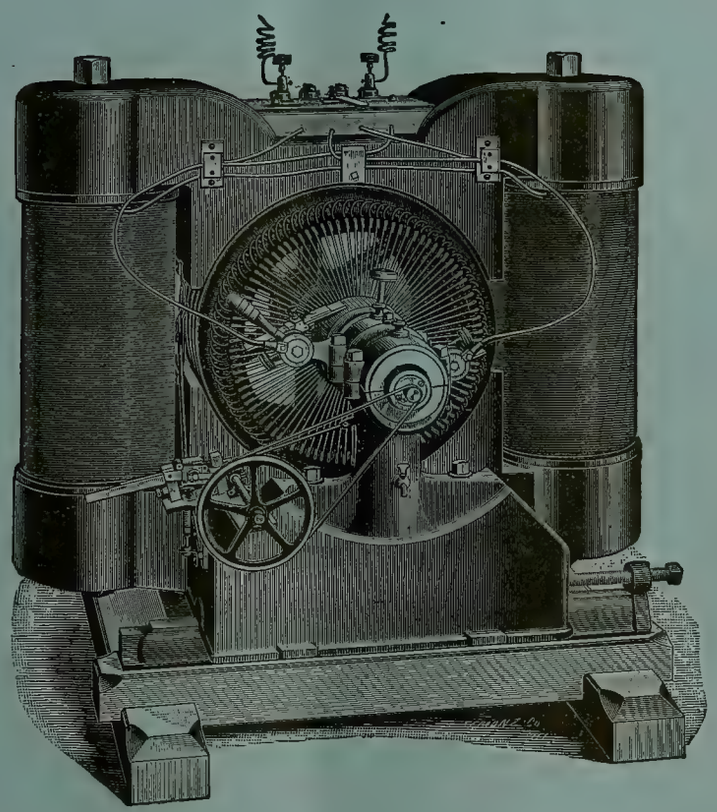

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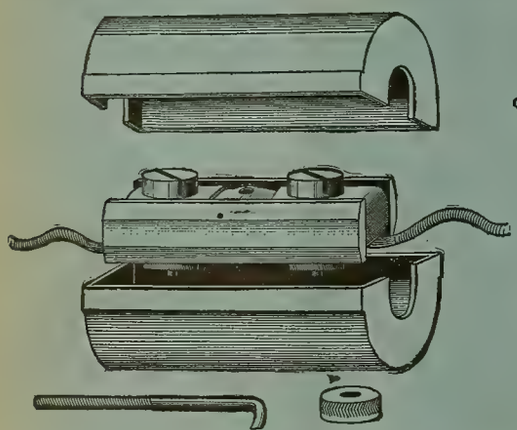

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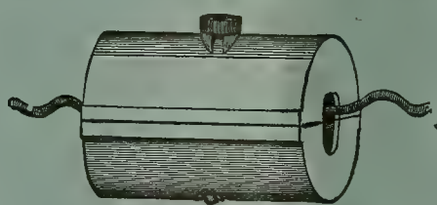

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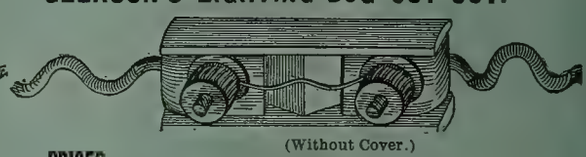

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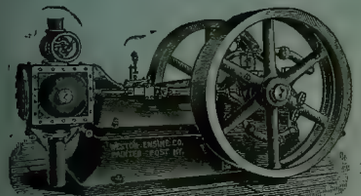

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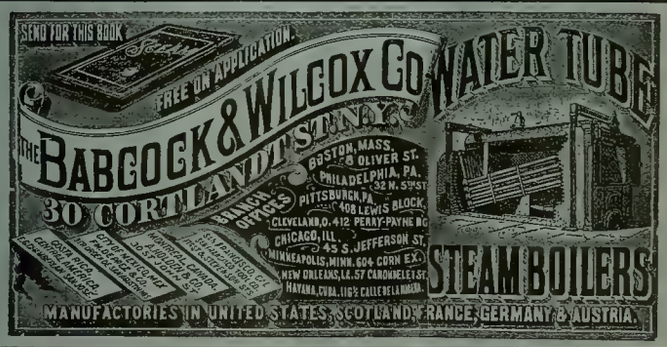

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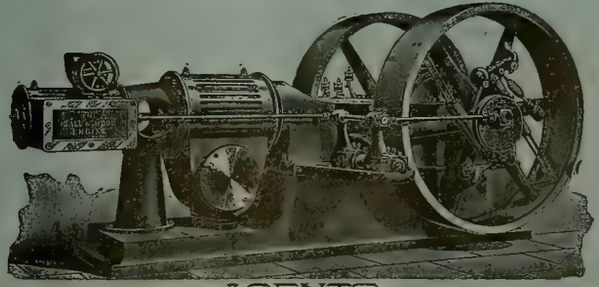

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Accumulators.
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Electric Storage Battery Co.

Adjusters, Lamp.
Dow Adjuster Co.

Annunciators.
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Arc Lamps.
C & C Electric Co.
Clark Electric Co,
Electric Appliance Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co.. The.
La Roche Electric Wks.
Little. F. P. Elec. C. & S. Co.
Mather Electric Co.
Royal Arc Electric Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
Taylor, Dee & Mack.
Westinghouse El. & Mfg. Co.

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Central Electric Co.
Electric Appliance Co.

Armature Winders.
Andrews & Haschke.
Stanwood M'f'g Co.

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Bradbury-Stone Elec. S. Co.
Bunnell & Co , J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Central Electric Co.
Columbia Rubber Wks. Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Law Battery Co.
Leclanche Battery Co., The.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Miamisburg Electric Co.
Peru Electric Mfg. Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.
White, S. S. Dental Mfg. Co.

Bells.
Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Belting.
Columbia Rubber Wks. Co.
Shultz Belting Co.

Boilers.
Babcock & Wilcox Co., The.
Clonbrock Steam Boiler Wks.
Freeman & Sons Mfg. Co.
Link Belt Machinery Co.
Racine Hardware Co.
Stirling Co., The.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Cables (See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar.**
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Bishop Gutta Percha Co.
Carter & Co., Geo. G.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Hill, W. S. Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Taylor, Dee & Mack.
Western Electric Co.

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Central Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co
Western Electric Co.

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Consolidated Car-Heating Co.

Clutches, Friction.
Falls Rivet & Machine Co.
Lake, J. H. & D. Co.
Link Belt Machinery Co.

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Fibre Conduit Co., The.

Construction & Repairs.
Allen-Hussey Co.
Amstutz, N. S.
Andrews & Haschke.
C & C Electric Co.
Capitol Model & Mach. Wks
Comstock Co., The Louis K
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co
Mather Electric Co.
Osburn, Harry G.
Stone, O. M
Wirt, Chas.

Contractors and Electric Light Plants.
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Capitol Model & Mach. Wks.
Carter & Co., Geo.G.
Clark Electric Co.
Colburn Electric Mfg. Co.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Fort Wayne Electric Co.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Merrill, Frederick L.
Monrath, Gustave.
Osborne Steam Eng. Co.
Osburn, Harry G.
Stone. O. M.
Wirt, Chas.

Electrical Instruments.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Queen & Company, Incorp.
Taylor, Dee & Mack.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.
Wirt, Chas.

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Edwards, W. S. Mfg. Co
Gleason, E. P. Mfg. Co.
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Colburn Electric Mfg. Co.

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Morse, Williams & Co.

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Ball & Wood Co., The.
Ball Engine Co.
Freeman Sons Mfg. Co.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Weston Engine Co.

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Diehl & Co.

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Standard Paint Co.
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Electric Appliance Co.
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Holtzer-Cabot Electric Co.

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Bryant Electric Co.
Bunnell & Co., J. H.
Capitol Model & Mach. Wks.
Carter & Co., Geo. G.
Central Electric Co.
Colburn Electric Mfg. Co.
Cooke, E. D.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Law Battery Co.
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Bernard Co., The E. G.
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Fibre Conduit Co., The.
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Hemingray Glass Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Moore, Alfred F.
Munsell & Co., Eugene.
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Okonite Co., The.
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Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.
Vulcanized Fibre Co.
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Carter & Co., Geo. G.
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Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
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Cooke, E. D.

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Buckeye Electric Co
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Central Electric Co.
Electric Appliance Co.
General Electric Co.
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Metropolitan Electric Co.
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Taylor, Dee & Mack.
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Central Electric Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Wirt, Chas.

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(See Insulated Wires.)

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Munsell & Co., Eugene.

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Electric Appliance Co.
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Queen & Co. Incorp.
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Webster & Co., Warren.

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Cushing & Morse.
Chicago Ins. Wire Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Paint Co.
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Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S
Metropolitan Electric Co.
Stone, O. M.
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D'Unger Elec. Tel. Mfg. Co.
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Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.
Smith, S. Morgan.

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Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
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Elkhart Transformer.

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Notice is hereby given that the undersigned Assignee will receive bids in writing for the entire unsold stock of The Ansonia Electric Company, insolvent, or any portion thereof, situated in Cook County, Illinois; also for the book accounts and bills receivable; also for the good will, electrotypes, catalogues, and all other property of said company, situated in Cook County, Illinois.

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The stock on hand alone is estimated to be worth at forced sale prices, at least $20,000. Lists of stock and the stock itself may be seen at the above address, and lists of the larger part of the stock will be mailed to anyone on application. A certified check must accompany each bid for 10 per cent. of the bid, which will be returned to the bidder if the bid is not accepted. Terms cash. All bids subject to approval by the County Court of Cook County. Bids have already been received which will be accepted if no better shall be offered. Write us for information, which will be cheerfully given by mail or otherwise, on application.

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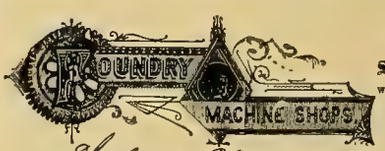

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Maquoketa, Iowa, ... 189 .

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They give a very Clear Steady white light, entirely free from the flashing and dying out of the ordinary Circuit Current arc Lamp.
Yours Truly
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That is what we want to impress upon the convolutions in your dome of thought. We want to get this new address tangled in the skein of your reveries,

173-175 Adams Street,

Adams Street; um, yes; named after John Quincy Adams—Patriot, Statesman, Diplomatist, Scholar, Sage.

But about this building of ours—if we had consulted an architect, Burnham, maybe, and said:

"Look here, Burnham, old man,
(Jess let up on Carlisle fer a while,)
We want you to draw and figger and plan
And get us up the best building you can."
And he'd done it, we don't believe, by jing!
That he'd made a single thing
That 'ud a suited us better,
Jess naturally fitted, square to the letter.

We are in the very heart of the business district; convenient to banks, express offices, depots; one block from post-office, adjacent to other towering hives of business; we are right in the buzz of the wheels of trade and propose to do some of the bumbling ourselves. While we were fixing up we arranged special departments for our leading specialties: **Helios Arc Lamps, Interior Conduit, Okonite Wire, Pharos Incandescent Lamps,** and a **raft** of other things which we will float into notice in proper season.

Call around and shake hands with us or send your regrets by mail.

Central Electric Co.,

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FORT WAYNE, IND.,

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Arc Lamps for Constant Potential Alternating or Railway Circuits.

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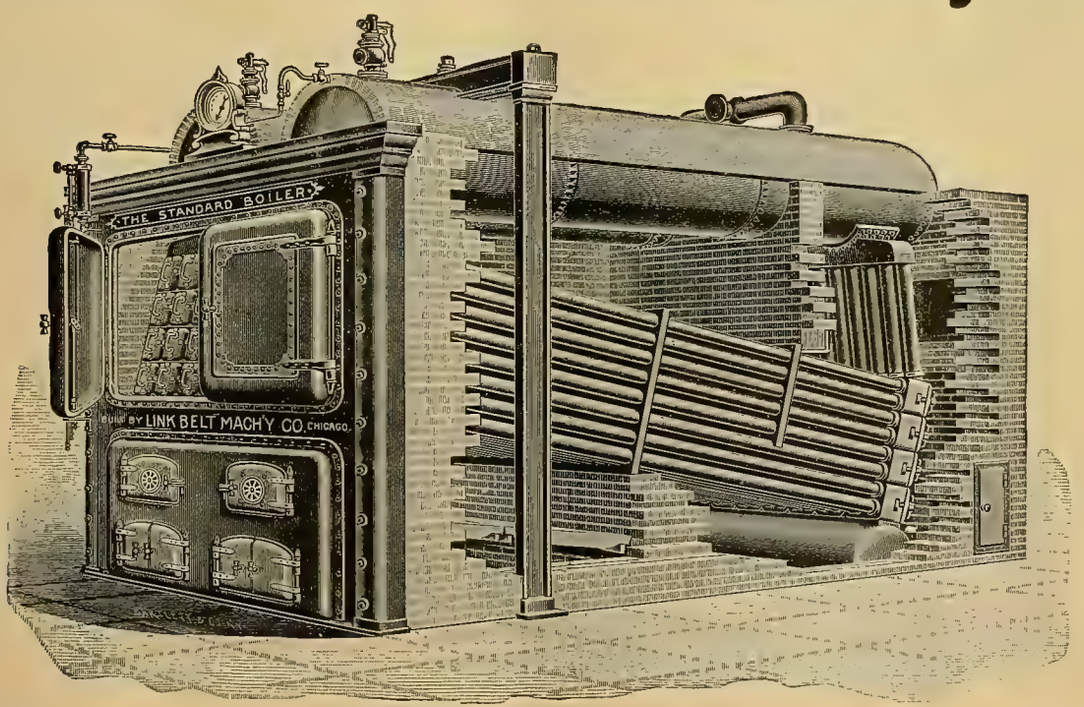

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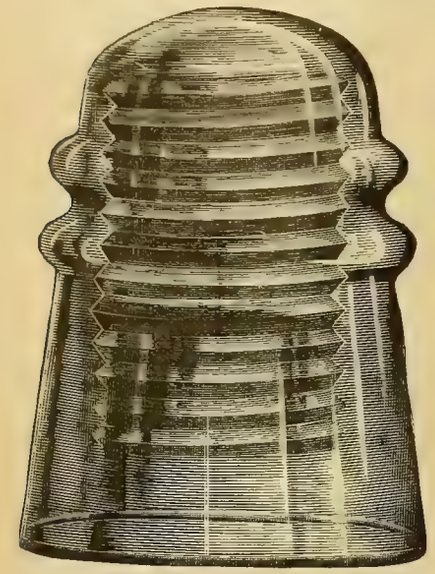

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Of all styles?

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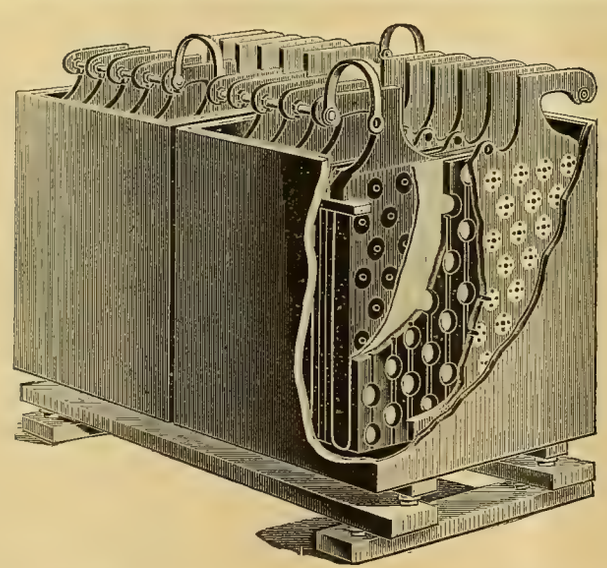

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Up to 100 H. P.

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Isolated lighting plants, Central Station Apparatus.

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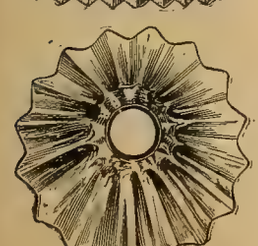

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17 in. diameter,	2¼ in. holder,	$ 9.00
8 " "	2¼ " "	10.00
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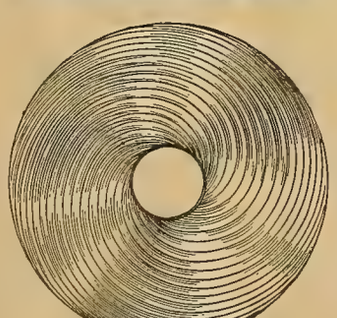

Flat Spiral Corrugated.

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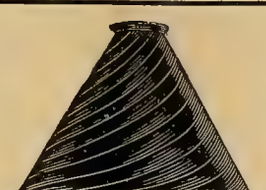
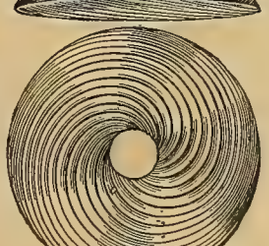
8 in. diameter,	2¼ in. holder,	$ 8.00
10 " "	2¼ " "	9.00





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Made in all staple sizes of electric shades.
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The best on the market.

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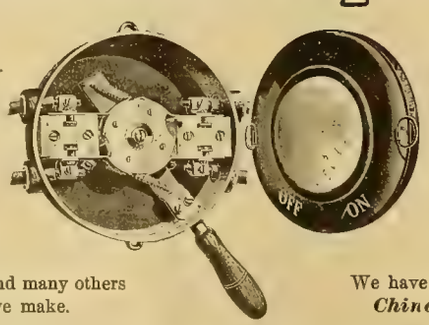

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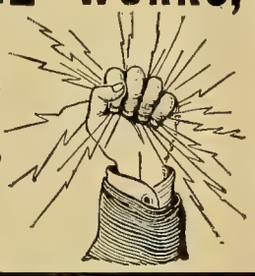
AMERICANITE. MAGNET. OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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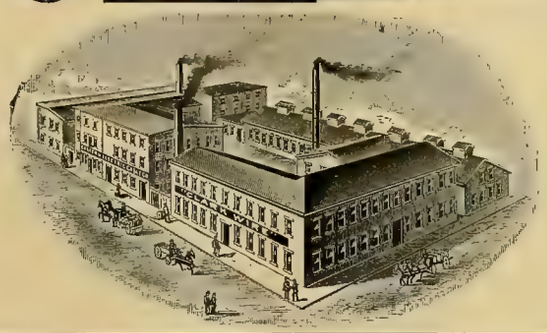

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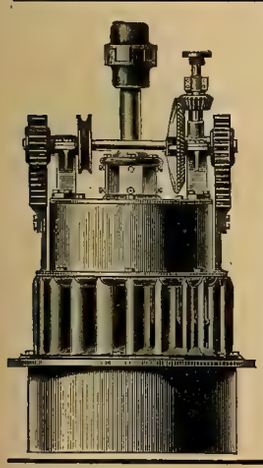

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Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with me, **as I am willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

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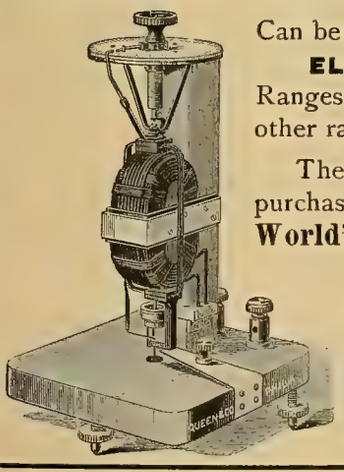

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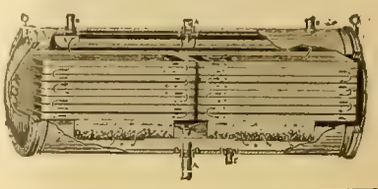
Stilwell's Patent Live Steam-Feed Water Purifier.



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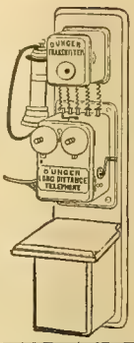

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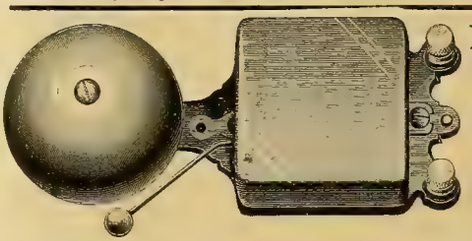

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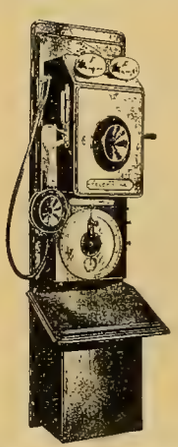

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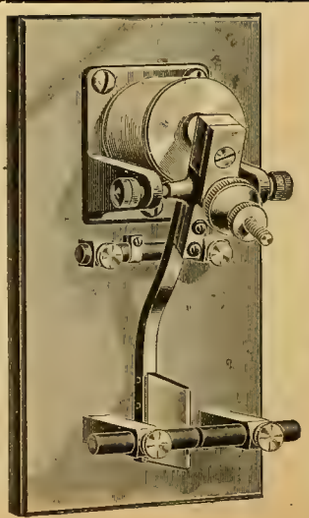

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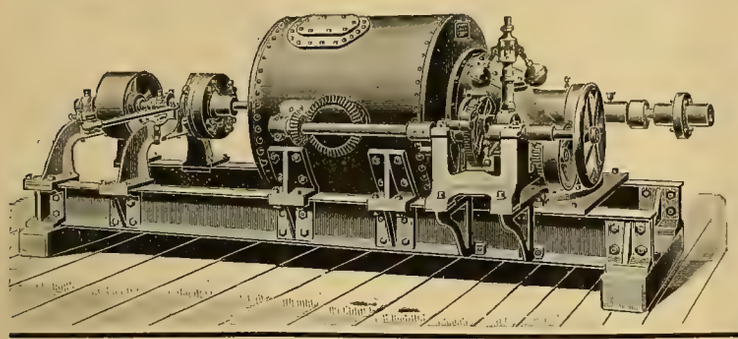

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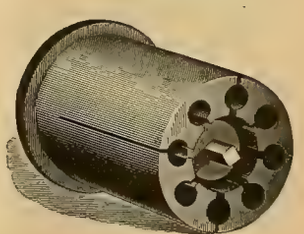

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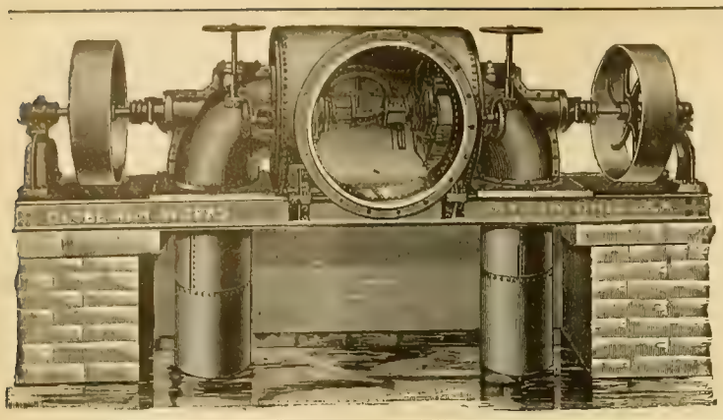

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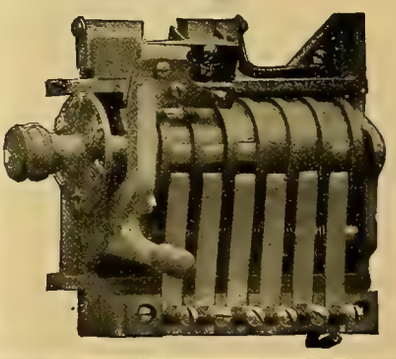

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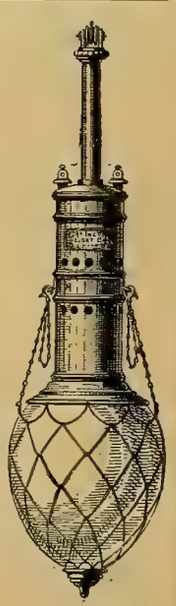

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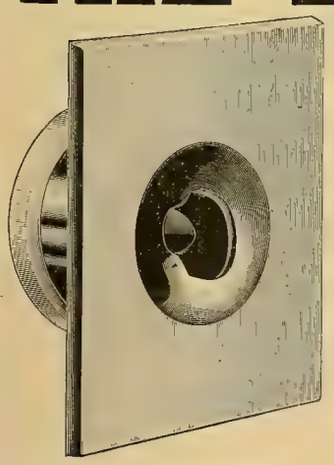

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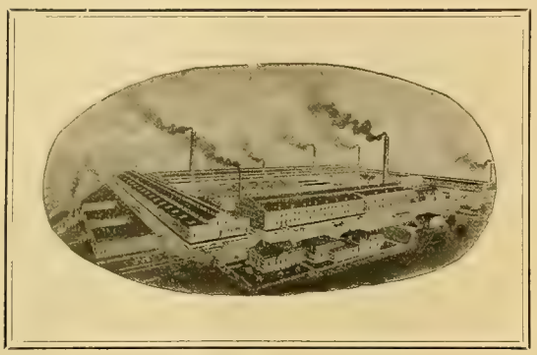

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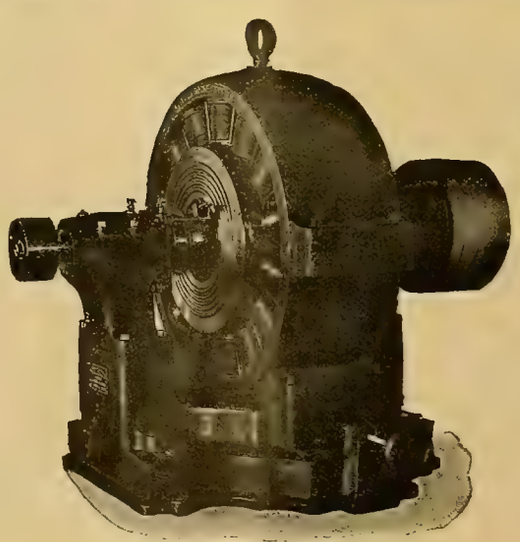

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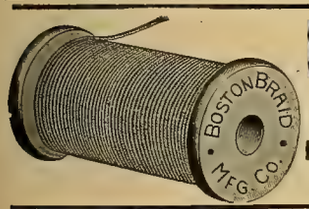

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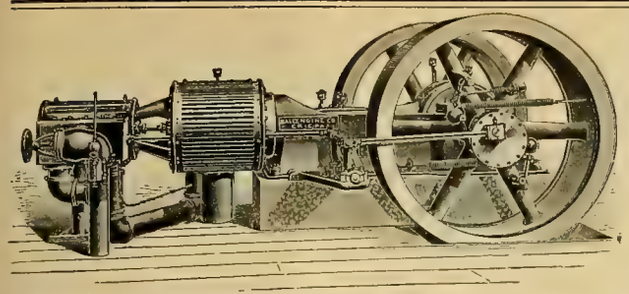

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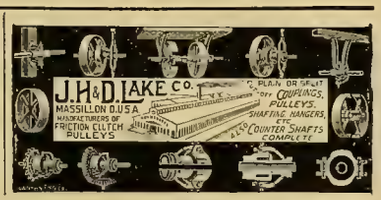

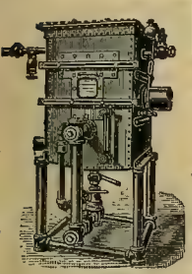

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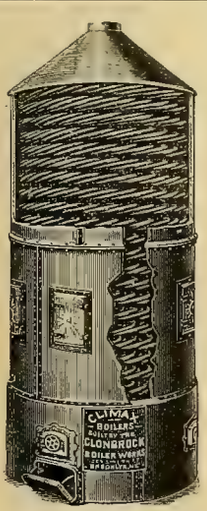

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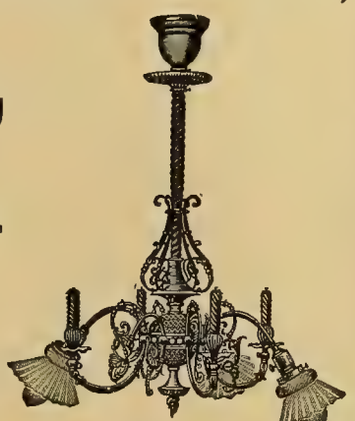

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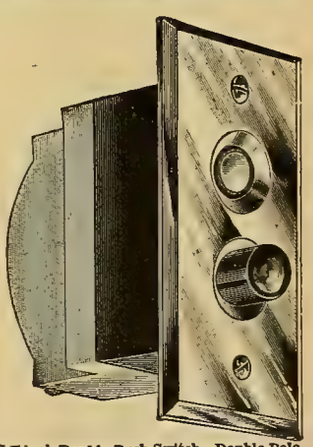

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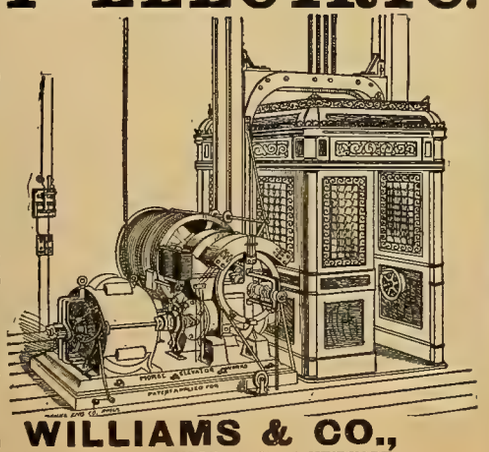

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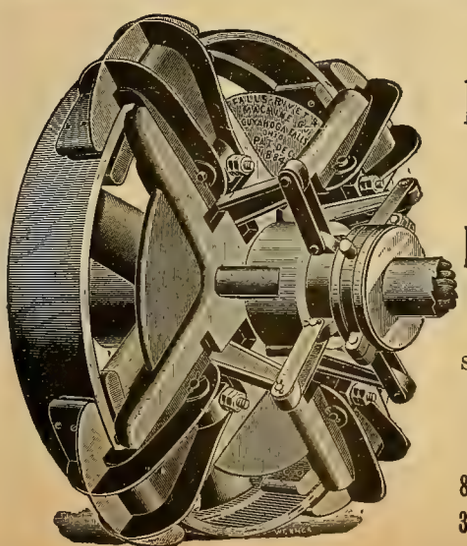

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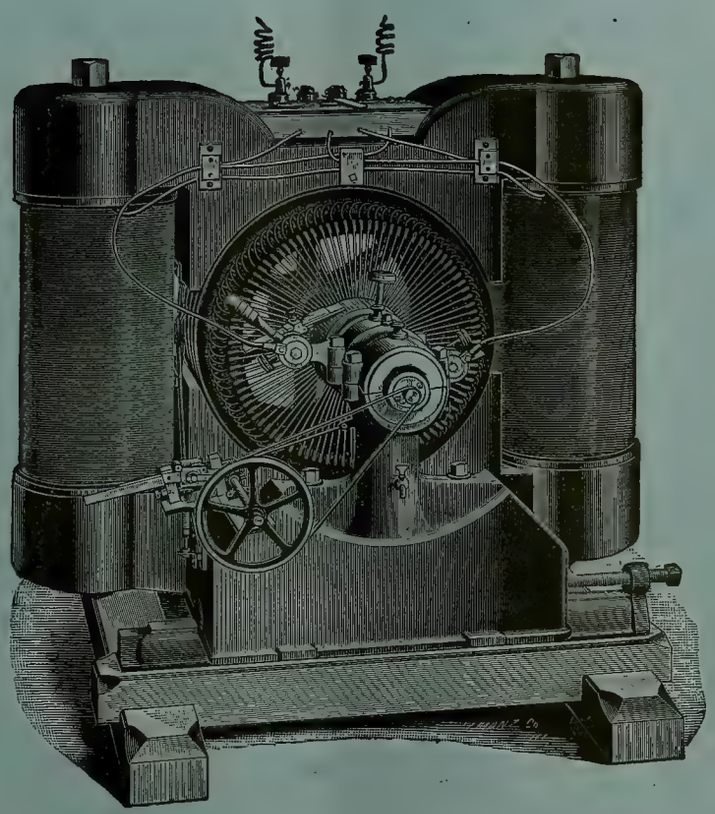

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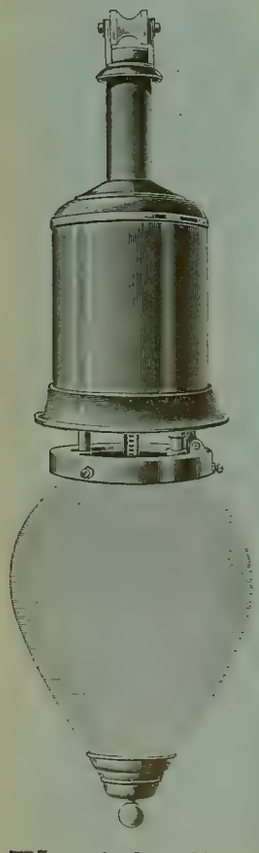

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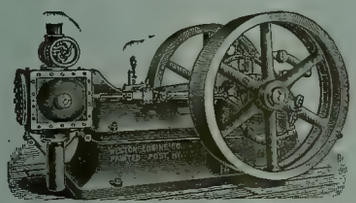

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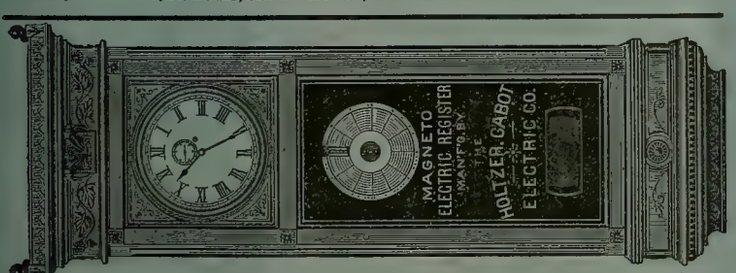

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Electric Storage Battery Co.

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Dow Adjuster Co.

Annunciators.
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Metropolitan Electric Co.
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Taylor, Dee & Mack.
Western Elec. Supply Co.

Arc Lamps.
C & C Electric Co.
Clark Electric Co,
Electric Appliance Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Royal Arc Electric Co.
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Standard Electric Co.
Taylor, Dee & Mack.
Westinghouse El. & Mfg. Co.

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Central Electric Co.
Electric Appliance Co.

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Andrews & Haschke.
Stanwood Mf'g Co.

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Butler Hard Rubber Co.
Carter & Co., Geo. G.
Central Electric Co.
Columbia Rubber Wks. Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Law Battery Co.
Leclanche Battery Co., The.
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Metropolitan Electric Co.
Miamisburg Electric Co.
Peru Electric Mfg. Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Bells.
Central Electric Co.
Electric Appliance Co.
Greely & Co., The E. S.
Huebel & Manger.
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Ostrander & Co., W. R.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Belting.
Columbia Rubber Wks. Co.
Shultz Belting Co.

Boilers.
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Clonbrock Steam Boiler Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Link Belt Machinery Co.
Racine Hardware Co.
Stirling Co., The.
Weston Engine Co.

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Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Western Electric Co.
Western Elec. Supply Co.

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Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar.**
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Bishop Gutta Percha Co.
Carter & Co., Geo. G.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Hill, W. S. Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Taylor, Dee & Mack.
Western Electric Co.

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Central Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co.
Western Electric Co.

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Consolidated Car-Heating Co.

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Lake, J. H. & D. Co.
Link Belt Machinery Co.

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Fibre Conduit Co., The.

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Amstutz, N. S.
Andrews & Haschke.
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Capitol Model & Mach. Wks.
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La Roche Electric Wks.
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Stone, O. M.
Wirt, Chas.

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Arnold, B. J.
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Bryan, Wm. H.
C & C Electric Co.
Capitol Model & Mach. Wks
Carter & Co., Geo. G.
Clark Electric Co.
Colburn Electric Mfg. Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Fort Wayne Electric Co.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Siemens & Halske Elec. Co.
Stone, O. M.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

Copper.
Law Battery Co.
Miamisburg Electric Co.

Copper Wires.
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Bishop Gutta Percha Co.
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Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

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Brownlee & Co.
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Electric Appliance Co.
Metropolitan Electric Co.
Taylor, Dee & Mack.

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Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Carter & Co., Geo. G.
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Hart & Hegeman Mfg. Co.
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Huebel & Manger.
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Consolidated Eng. Co.
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Merrill, Frederick L.
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Osborne Steam Eng. Co.
Osburn, Harry G.
Stone, O. M.
Wirt, Chas.

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Bunnell & Co., J. H.
Carter & Co., Geo. G.
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Electric Appliance Co.
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Taylor, Dee & Mack.
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Independent Electric Co.

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Bryant Electric Co.
Bunnell & Co., J. H.
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Carter & Co., Geo. G.
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Colburn Electric Mfg. Co.
Cooke, E. D.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Hayden-Booker Mfg. Co.
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Western Elec. Supply Co.

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Baggot, E.
Gleason E. P. Mfg. Co.
Hemingray Glass Co.
Phœnix Glass Co.

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Dixon Crucible Co., Jos.

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Butler Hard Rubber Co.
Columbia Rubber Wks. Co.
Delaware Hard Fibre Co.

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Andrews & Haschke.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Chicago Ins. Wire Co.
Columbia Rubber Wks. Co.
Cutter Elec. & Mfg. Co.
Delaware Hard Fibre Co.
Electric Appliance Co.
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Fibre Conduit Co., The.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
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Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
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Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Moore, Alfred F.
Munsell & Co., Eugene.
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New York Insulated Wire Co.
Okonite Co., The.
Peru Electric Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.
Vulcanized Fibre Co.
Western Elec. Supply Co.

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Bunnell & Co., J. H.
Carter & Co., Geo. G.
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Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

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Cooke, E. D.

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Bernstein Electric Co.
Buckeye Electric Co
Carter & Co., Geo. G.
Central Electric Co.
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Mather Electric Co.
Metropolitan Electric Co.
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Taylor, Dee & Mack.
Westinghouse Elec & Mfg. Co.

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Central Electric Co.
Electric Appliance Co.
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Wirt, Chas.

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(See Insulated Wires.)

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Mica.
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Munsell & Co., Eugene.

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Independent Electric Co.
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C & C Electric Co.
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General Electric Co
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Mather Electric Co.
Palmer Bros.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Westinghouse El. & Mfg. Co.

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Standard Paint Co.

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Baker & Co.

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Brownlee & Co.

Porcelain.
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Phœnix Glass Co.

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Electrician Publishing Co.
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Electric Appliance Co
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Steam Pumps.
Worthington, Henry R.

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Stoves, Electric.
Consolidated Car-Heating Co

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Brill, J. G. Co.

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Cushing & Morse.
Chicago Ins. Wire Co.
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Metropolitan Electric Co.
Moore, Alfred F.
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Phillips Insulated Wire Co
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Central Electric Co.
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General Electric Co.
Westinghouse El. & Mfg. Co.

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Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stilwell & Bierce Mfg. Co.

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Cor. School of Mechanics.
Correspondence School of Technology.
Rose Polytechnic Institute.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.
Smith, S. Morgan.

Wire, Bare.
Anderson, Albert & J. M.
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Crescent Ins. Wire & Cable Co
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Notice is hereby given that the undersigned Assignee will receive bids in writing for the entire unsold stock of The Ansonia Electric Company, insolvent, or any portion thereof, situated in Cook County, Illinois; also for the book accounts and bills receivable; also for the good will, electrotypes, catalogues, and all other property of said company, situated in Cook County, Illinois.

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Philadelphia Penn'a

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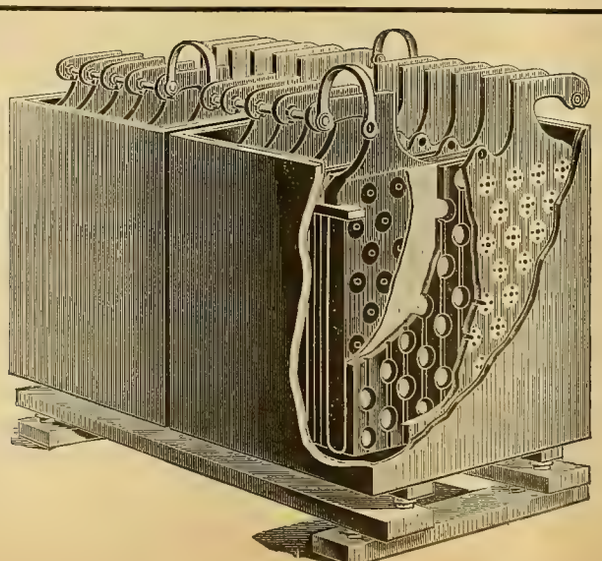

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CHICAGO.

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This Coupon attached to any order reaching us on or before May 15, 1894, will entitle the purchaser to **an extra discount of 5 per cent.**

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The Central Electric Co.,

173-175 ADAMS STREET,

Formerly
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CHICAGO.

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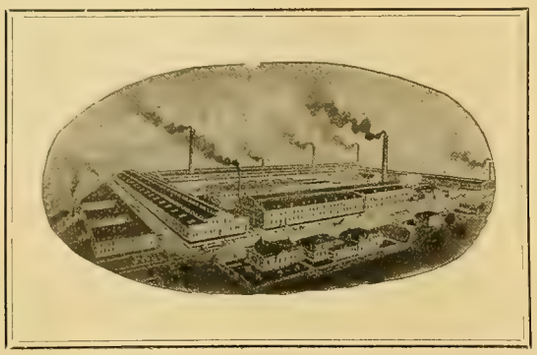

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Everything about it is of the very best. Brass Frame, Brass Shell, Brass Cap, Brass Rods. No tin or stovepipe iron. It combines unequaled simplicity with absence of all objectionable features heretofore present in alternating lamps. It is a **NON-STICKER** that central station men and lamp trimmers will be **STUCK** on because they don't have to **MONKEY** with it every few days, taking it down to clean and oil. Lamps for all systems. We guarantee every lamp. Write for prices.

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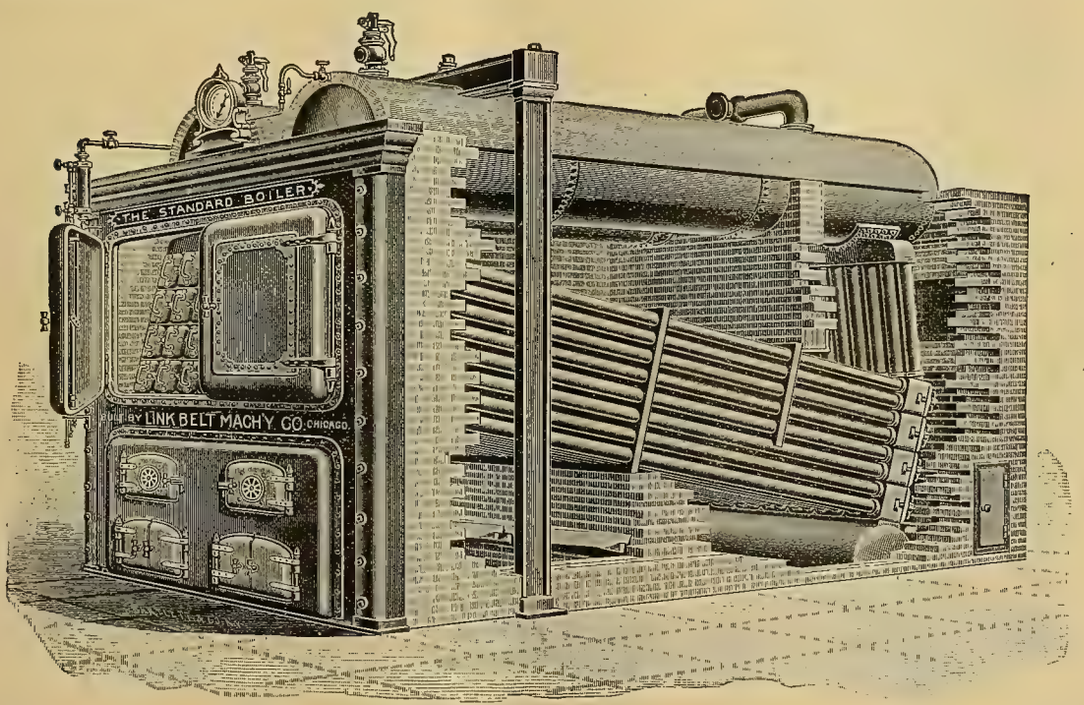
Manufacture The Caldwell

Standard Water Tube Safety Boiler.

ABSOLUTE SAFETY WITH



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TO FIT ANY STANDARD SOCKET.

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"IDEAL" INSULATED COPPER WIRE.

Best Substitute for Rubber.

HIGH INSULATION. LONG LIFE. LOW COST.

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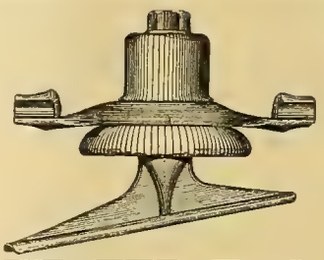

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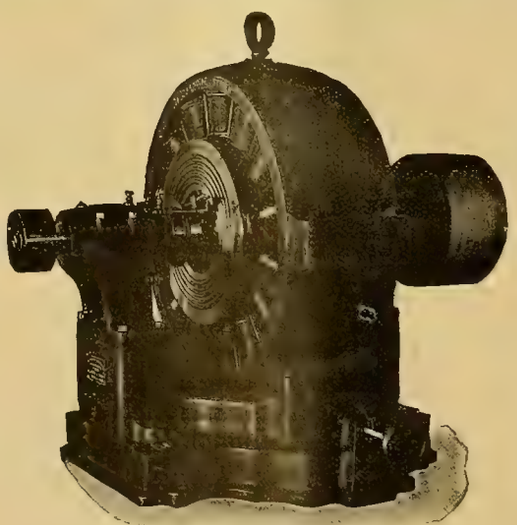

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of lamps, who have not as yet tried our

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are doing themselves an injustice in not giving them one trial. Try it and see if what you may have thought of them is all right, or all wrong.

We are Western Agents for the Viaduct Products, including **TELEPHONES, Switchboards, Magneto Bells, Receivers, Transmitters**, etc., etc. Write for our descriptive pamphlet. These goods are generally acknowledged to be the best on the market.

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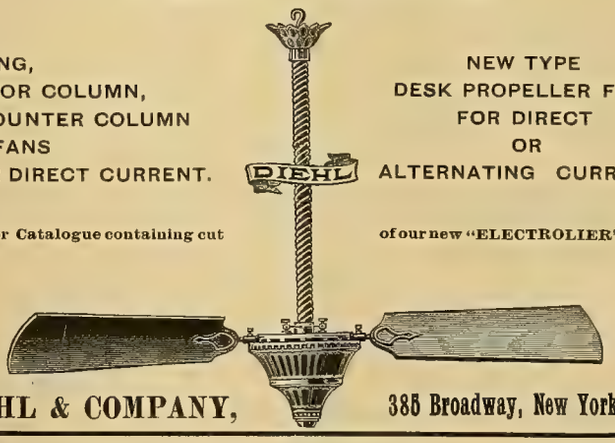

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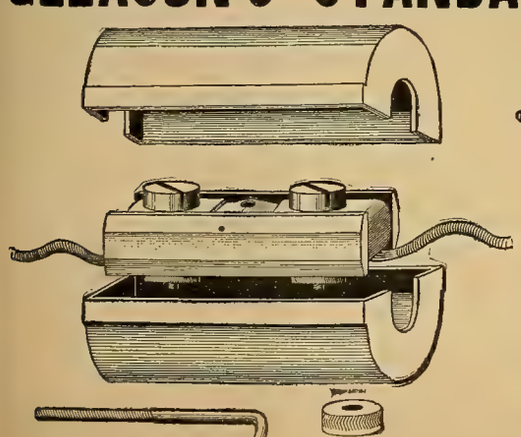
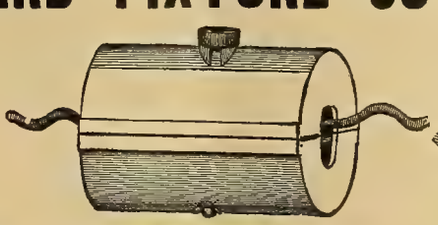


Enlarged cut showing construction of Gleason's Porcelain Lighting-Bug Cut-Out covered with porcelain.



FULL SIZE CUT (When Closed)

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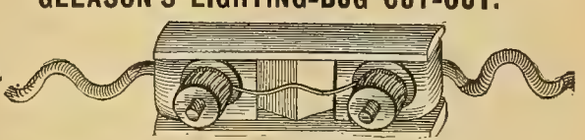
Gleason's Porcelain Lighting-Bug Cut-Out,
with porcelain cover.

Smallest Covered Solid Porcelain Cut-Out on the Market.

Price Each, Complete, 22½ cts. List.

GLEASON'S LIGHTING-BUG CUT-OUT.



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Price Each 10 cts., in Porcelain.

PRICES SUBJECT TO REGULAR DISCOUNT.

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Best and Smallest Cut-Out Made.

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I have purchased the Wirt Laboratory from the assignee of the Ansonia Electric Co., together with a large stock of Wirt Indicators; these instruments are all new and in first-class condition. They include indicators for direct and alternating current ranging from 10 to 1,000 amperes and from 2½ to 3,000 volts. While this stock lasts I will make extremely low prices. Apply to the undersigned or to your regular dealer

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Cleats, 2 or 3 wire, glazed,	**$30.**	per 1,000
Insulators, "	**12.**	" "
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SHADES (patented), made of thin, polished brass, lacquered, brilliant, beautiful, light and entirely new. Easily and securely adjusted to standard sockets. (No Collar.) Price $6.00 per doz. Good discount to trade.

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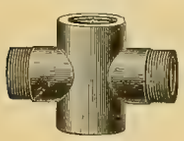

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LIGHT, STRONG AND DURABLE. **NOT AFFECTED BY ACIDS OR ALKALIES.**
A PERFECT INSULATOR.

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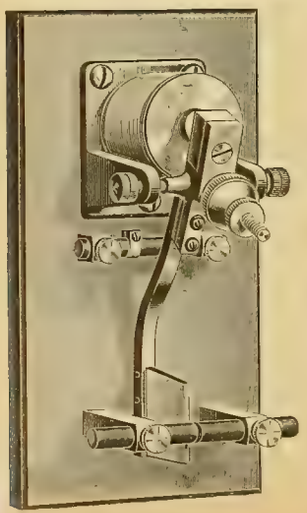

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Look out for **THUNDER** storms and protect yourselves and apparatus by ordering at once the

Doane Lightning Arrester.

It is absolutely positive, and limits the current following the lightning discharge to an amount that cannot do any possible injury.

HIGH GRADE RAILWAY, INCANDESCENT, ALTERNATING OR POWER SWITCH BOARDS AND SWITCHES.

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The "Ideal" Storage Battery

For all Classes of Work where Light and Power are Required.

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Yours truly, THOS. R. LOMBARD, General Manager.

Thousands in use all over the country.

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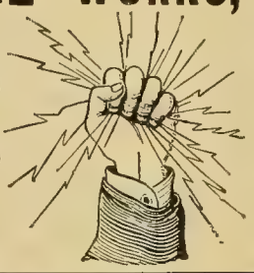

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The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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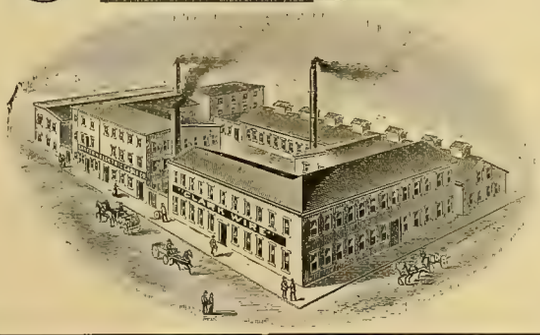

In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."

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We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

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Important to Lighting Stations!

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ALTERNATING CURRENT INDICATORS

Are now ready. Before purchasing elsewhere send for our Supplementary Catalogue which contains the prices and description of the above instruments, and also a list and prices of other ***new instruments*** of our manufacture.

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But have your burned-out armature rewound by us with our

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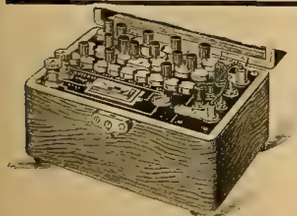

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QUICK SALE.

To clear up stock before summer, we will sell regardless of original cost some odd pieces of apparatus for Electrical Measurement. This is a rare opportunity for electricians to secure good apparatus at a fraction of cost. Send for Circular No. 554.

Measure Resistance Quickly by the Acme Portable Testing Set.

Complete with bridge (theoretical range .01 to 10,000,000 ohms) D'Arsonval Galvanometer, Testing Battery and Key in a box 8x6x5 inches, weighing but six pounds. Send for Circular No. 524.

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COMBINATION

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One 50 light American arc dynamo, with fifty lamps, in first-class condition, $1,000; one 50-light, 1,200 C. P Gramme Thomson-Houston arc dynamo, $750; 150 ampere slate base D. P. switches, each $6; 100 ampere slate base D. P switches, each $3.50; 50 ampere slate base D. P. switches, each $2; Ajax railway switches, 100 to 400 amperes, single pole, quick break, $5.00.

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The advertiser is looking about for a good opening for a Central Station plant, south or west of Chicago, in a prosperous city or large town. Anyone who can give information of such a chance is invited to address **"X. Y. Z.,"**

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WANTED.

Salesman for incandescent lamps. State experience and salary. Address **"M. F. G.,"**

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The city of Hawarden, Iowa, will receive bids for a complete electric light plant; bids to be opened May 15. Plans and specifications on file with the **City Recorder** after May 9, 1894.

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For specifications, etc., apply to
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With privilege of purchase, an electric light plant in city of from eight to ten thousand inhabitants. State particulars in detail and terms in first letter. Address *"Lease,"*

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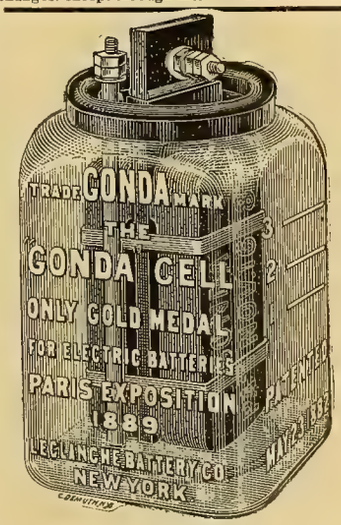

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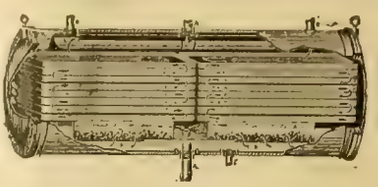

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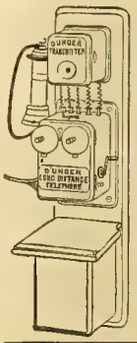

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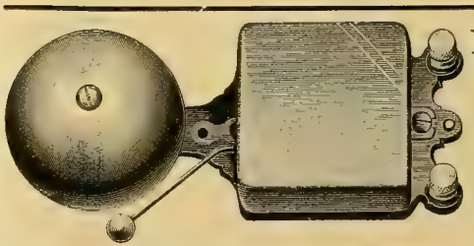

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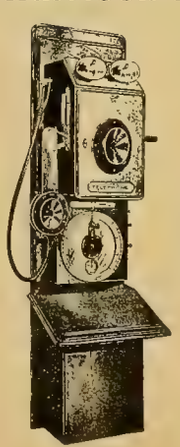

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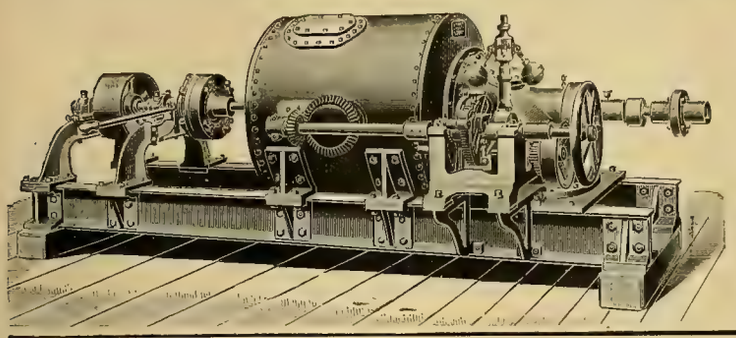

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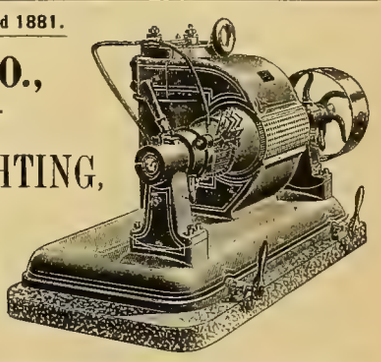

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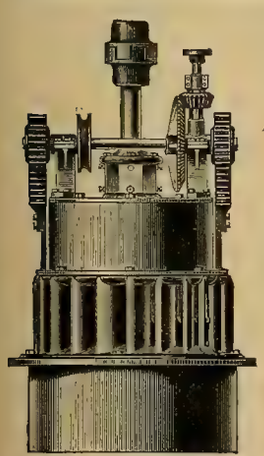

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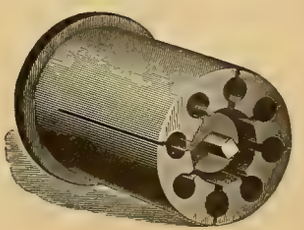

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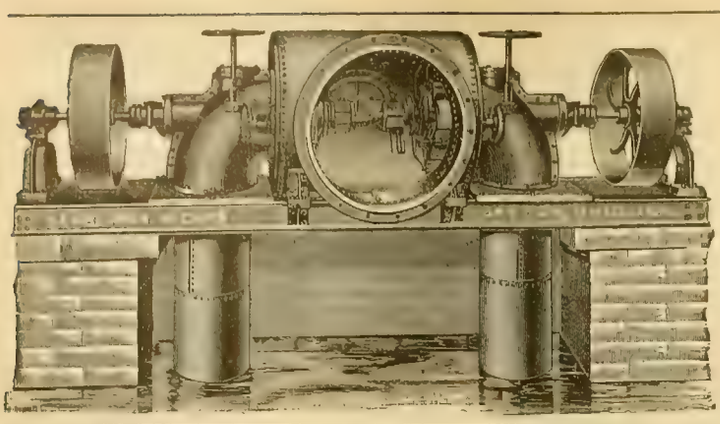

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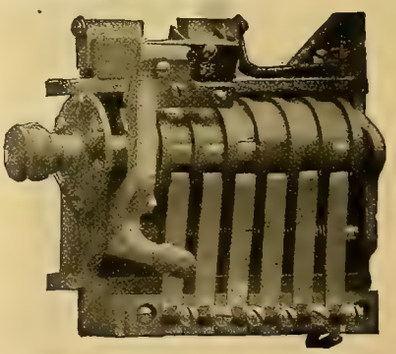

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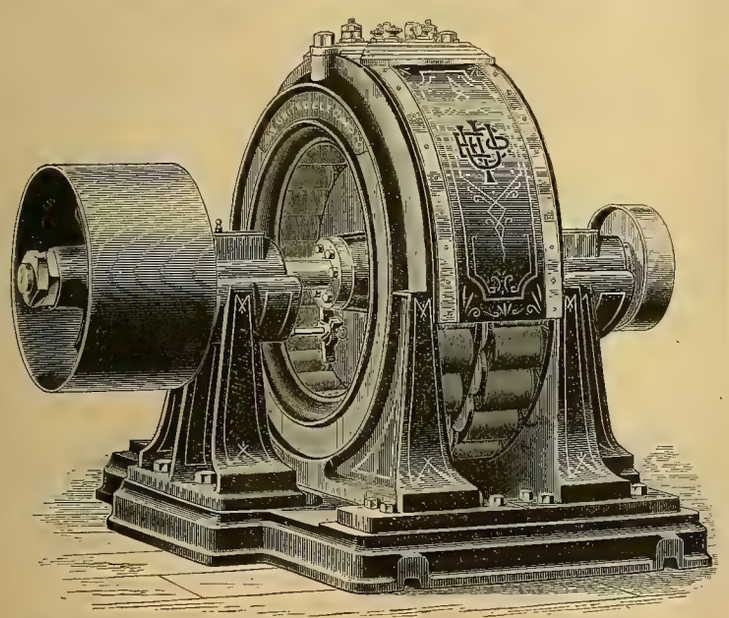

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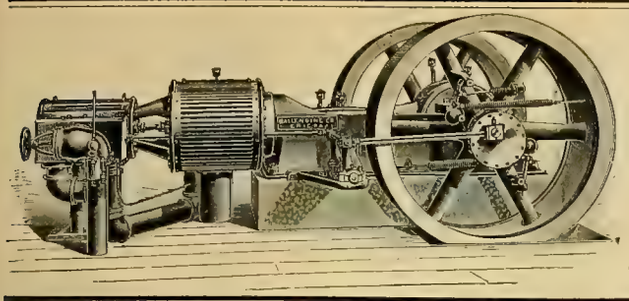

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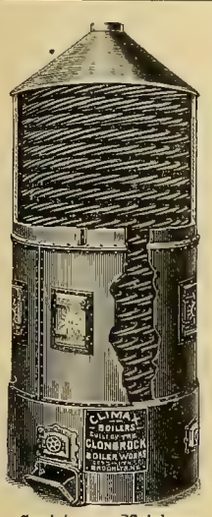

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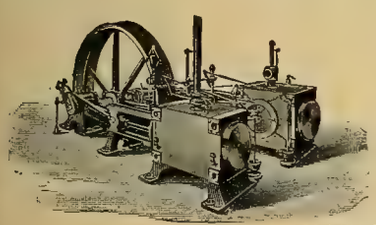

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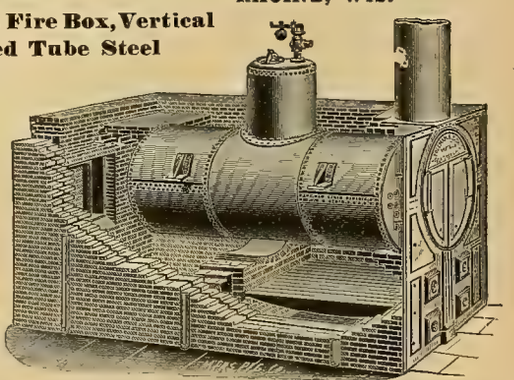

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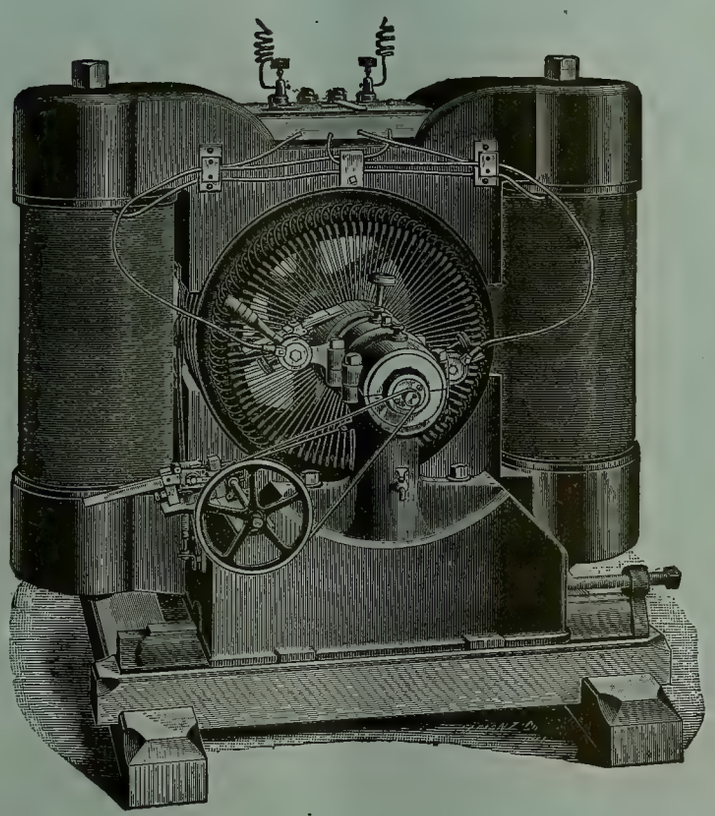

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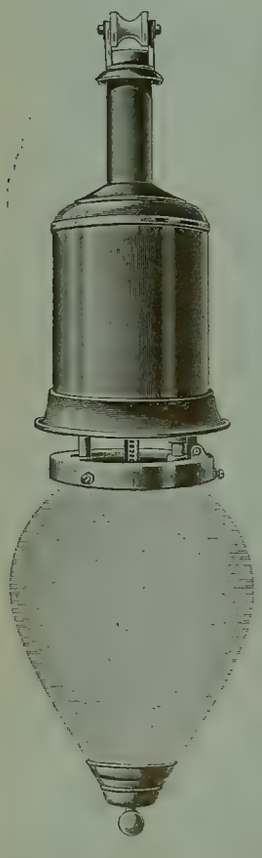

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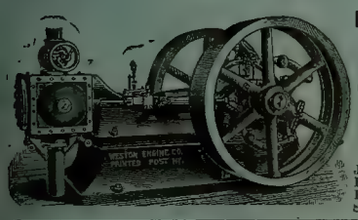

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For all business outside the United States and Canada—Thomson-Houston International Electric Co., Schenectady, N. Y.
For Canada—Canadian General Electric Co., Ltd., Toronto, Canada.

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Partridge Carbon Co.
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Freeman Sons Mfg. Co.
Racine Hardware Co.
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Water Heaters.
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Water Wheels.
Leffel & Co., Jas.
Smith, S. Morgan.

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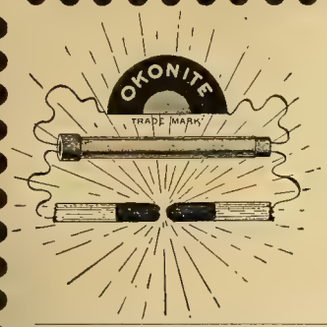

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173-175 ADAMS STREET,
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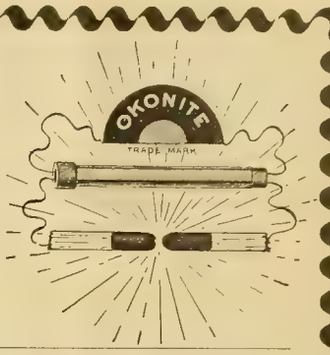


General Western Agents: Okonite Wires, Interior Conduits, Washington Carbons, Lundell Fan Motors.

$10.00 Reward!

Some vindicative individual with malice prepense mailed the following "poem" to us anonymously. While we are adverse to paying any attention to anonymous communications, unless accompanied by the cash, we feel impelled to publish this as a simple matter of self-defense. We have lost hours of sleep with the abominable rhyme jingling in our ears, trying to translate the somewhat obscure meaning. To relieve ourselves of further worry, we decided to stop worrying, and offer the following

REWARD!—To the central or isolated station manager, or electrician, sending us the first correct rendition of the verses into plain English, we will give $10.00 worth of Electrical Merchandise to be selected from our catalogue, allowing usual trade discounts. Open until June 1, 1894. Address

Advertising Department,
CENTRAL ELECTRIC CO.

THE ELECTRICIAN'S WOOING.

My darling, wire are you so cold?
Pray let my ohm be thine;
This system me a joy to hold
And pressure hand in mine.

Though you may search from pole to pole,
You'll find that I ampere
Of any one, so let us join,
No motor part my dear.

The gold our station will demand,
Our needs to gratify,
The circumstances I am in-
Candescently supply.

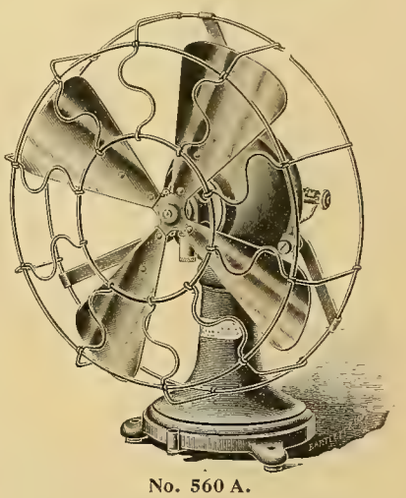
The current of my thought is toward
One central lamp of bliss,*
One heart I volt of there to cling
Need dynamo's it is?

So let us haste to lay our views
Before your pa and ma,
But, if they their consent refuse,
Let's skip the trolley-la.

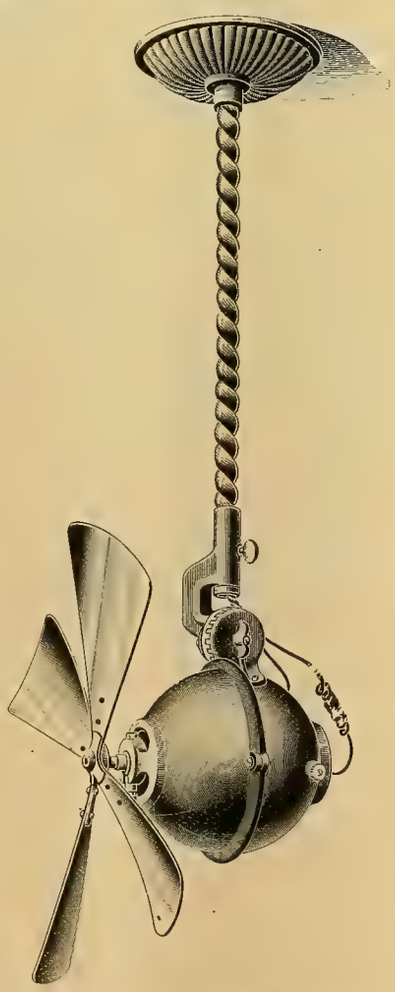
* The author evidently refers to the Pharos Incandescent Lamp.

Lundell Fan Motor Outfits.

No. 560A. 1-12 H. P., with switch giving 1,000, 1,400, 1,800 revolutions per minute. For constant current circuits of 110 to 120 volts. Self-oiling, self-aligning bearings, fixed brushes, NO SPARKING.



No. 560 A.



No. 567 H. SUSPENDED FAN OUTFIT. Lundell Motor.

1-6 H. P. Speed, 1,400 on constant current circuit, 110 to 120 volts. Standard length, from ceiling to end of fan, 4½ ft. on a 12 ft. ceiling.

The Lundell Fan Motors, of which these two are samples, are *unquestionably* the highest achievement in ventilating and comfort giving devices up to date.

They are scientifically designed, beautifully finished, compact (more so than any other make), noiseless; in fact as nearly perfect as we can hope to get.

If you contemplate establishing a drug store, restaurant or office circuit and *making money* hand over fist this summer, NOW is the time to collect your forces, deploy your fighting lines and *get ready*. We will help all we can and you will find that that's a good deal. A *good deal* all around. Fully illustrated catalogue to any address.

What we want is orders.

The Central Electric Co.,

CHICAGO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

MANUFACTURERS OF

ELECTRICAL MACHINERY

UNDER THE PATENTS OF JAMES J. WOOD.

For Arc Lighting, Direct Current Incandescent Lighting, Alternating Current Incandescent Lighting, Power Transmission either by Direct or Alternating Currents.
Arc Lamps for Constant Potential Alternating or Railway Circuits.

LOW PERIOD DIRECT CONNECTED ALTERNATORS.

The new "WOOD" Transformers have the highest efficiency and best regulation of any yet produced. They are easy to install, light weight and very handsome in appearance.
Parties requiring Transformers would do well to get our estimates before purchasing.

BRANCH OFFICES:

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CHICAGO, 185 Dearborn Street.
PHILADELPHIA, PA., 907 Filbert Street.
PITTSBURG, PA., 405 Times Building.
SYRACUSE, N. Y., Kirk Building.
COLUMBUS, OHIO, 57 E. State Street.
SAN FRANCISCO, Elec. Improvement Co., 43 Stevenson St.
NEW ORLEANS, LA., Southern Elec. Mfg. and Supply Co.
MINNEAPOLIS, MINN., New York Life Building.
CINCINNATI, OHIO, 206 Neave Building.
DALLAS, TEX., Cor. Main and Field Streets.
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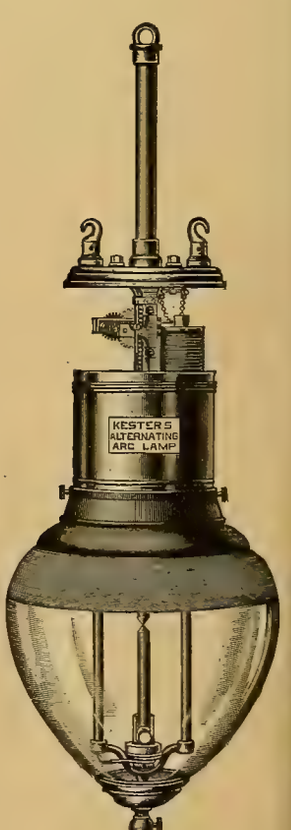
Don't make a Alternating Arc investigating

By Buying any Lamp before the



MON-ARC

Everything about it is of the very best. Brass Frame, Brass Shell, Brass Cap, Brass Rods. No tin or stovepipe iron. It combines unequaled simplicity with absence of all objectionable features heretofore present in alternating lamps. It is a **NON-STICKER** that central station men and lamp trimmers will be **STUCK** on because they don't have to **MONKEY** with it every few days, taking it down to clean and oil. Lamps for all systems. We guarantee every lamp. Write for prices.

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G. M. ANGIER & CO., Agents for New England.
116 Bedford St., Boston, Mass.

Western Office: METROPOLITAN ELECTRIC CO.,
186 and 188 5th Avenue, Chicago.

The Link-Belt Machinery Co.,

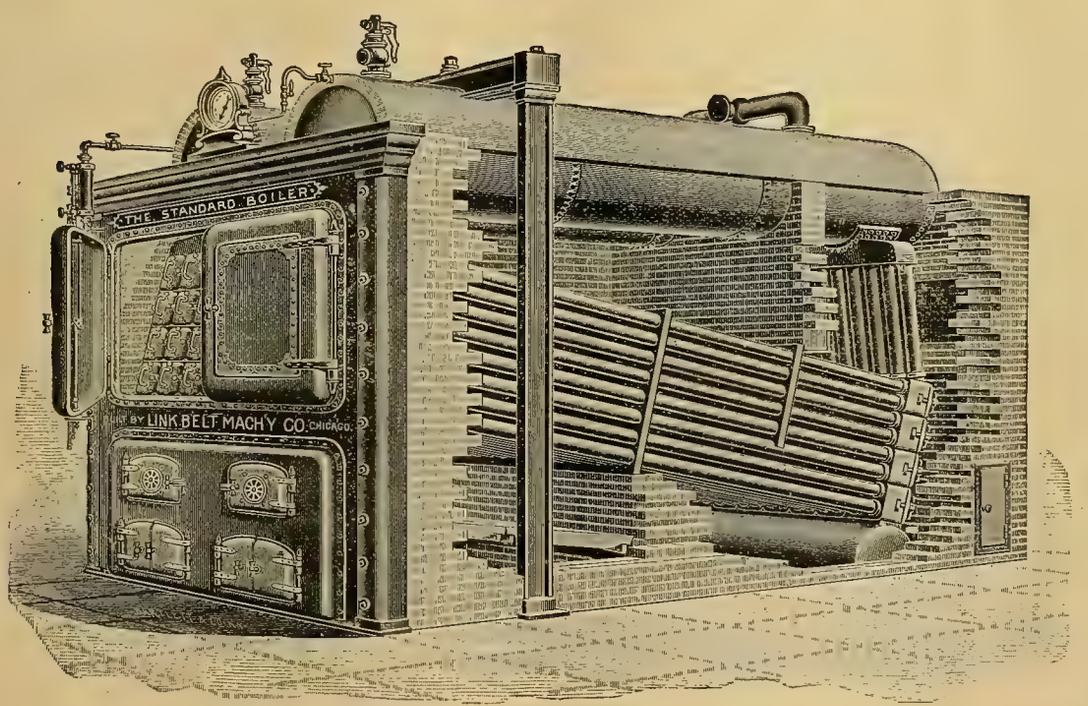
Engineers—Founders—Machinists,

General Office and Works, 39th St. and Stewart Ave.,
City Sales Office, 21 and 23 South Jefferson Street, **CHICAGO, U. S. A.**

Manufacture The Caldwell

Standard Water Tube Safety Boiler.

ABSOLUTE SAFETY WITH



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THE LINK-BELT COMPANIES,

Link-Belt Machinery Co., Chicago.
Link-Belt Engineering Co., Philadelphia and New York.

DESIGNERS AND BUILDERS OF

Machinery for Handling Coal and Ashes.

We have equipped the power plants of the following well-known firms with machinery for handling coal from cars, barges and wagons to boilers, and for taking ashes from under boilers to dump:

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Washburn & Moen Mfg. Co., Waukegan, Ill.
Spreckles Sugar Refining Co., Philadelphia, Pa.
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Illinois Steel Co., South Chicago, Ill.
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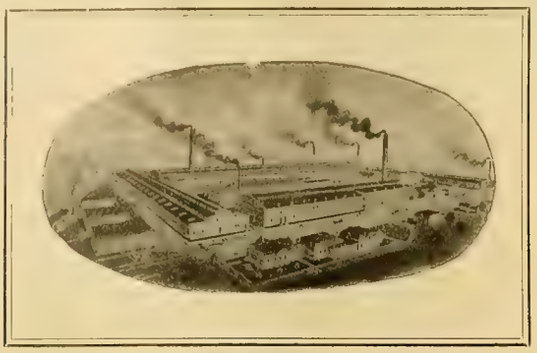
Electric Lighting and Power Apparatus



The Brush Double Arc Lamp Patents sustained by repeated decisions of U. S. Courts.

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BRUSH

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Agencies in all large cities.
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The "Ideal" Storage Battery

For all Classes of Work where Light and Power are Required.

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GENTLEMEN:—We take a great deal of pleasure in being able to laud the merits of the Bradbury-Stone Ideal Storage Battery for use in connection with the Phonograph. Within the last few months we have purchased in all several hundred of your cells, and have shipped them on orders to various parts of the country in almost every conceivable manner. They have withstood the most severe tests, and have in all cases given entire satisfaction.

Yours truly, THOS. R. LOMBARD, General Manager.

Thousands in use all over the country.

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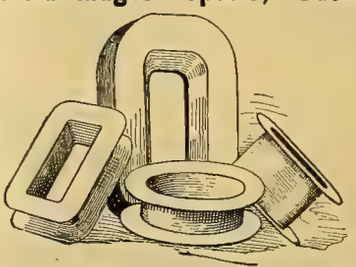
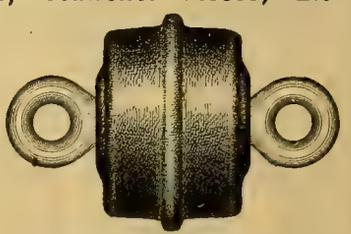
VULCABESTON,

Field Magnet Spools, Bushings, Controller Pieces, Etc.





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Average Breaking strain 6,500 lbs.

MOULDED MICA Trolley Line Insulators.

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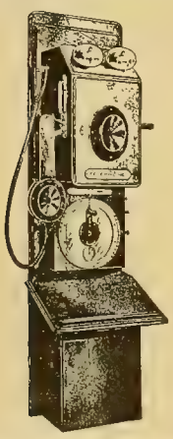
STEPHEN B. ELKINS, Prest. PATRICK EGAN, Sec'y. H. J. HANFORD, Gen'l Mgr.

The Harrison International Telephone Co.



WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE

Harrison International Telephone.

We either sell our telephones outright or lease them for a term of years.

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

Prospectuses furnished by addressing the Company at their offices,

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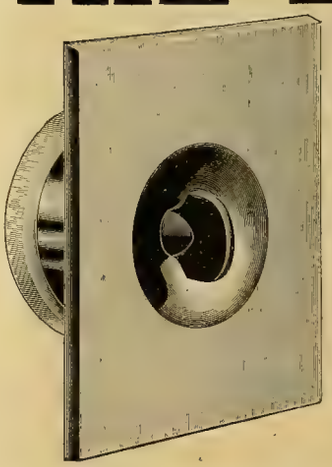
THE LATEST.



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Gibbs Switches, Gibbs Switches, Gibbs Switches,
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"DON'T YOU FORGET IT!"

Sockets, Dovetail Rosettes, Wall Receptacles, Etc.

The Perkins Electric Switch Mfg. Co.,

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Send for our new Catalogue and Prices.

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MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

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Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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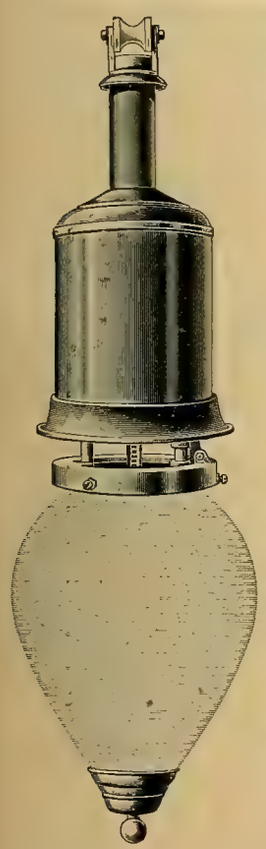

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You have seen our special offer on 1,000 "Ward" lamps, direct current. Well, the sale is fairly under way. If you desire anything in this line, let us hear from you quickly. State full particulars and quantity that you wish figures on.

Electric Construction & Supply Co.,

Telephone Building, New York.

Established 1881.

Unity Building, Chicago

TELEPHONE WIRE AND CABLES.

Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Cut Last and Out Class any other on the Market.

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NO BELTS. NO SHAFTING.

CEILING,
FLOOR COLUMN,
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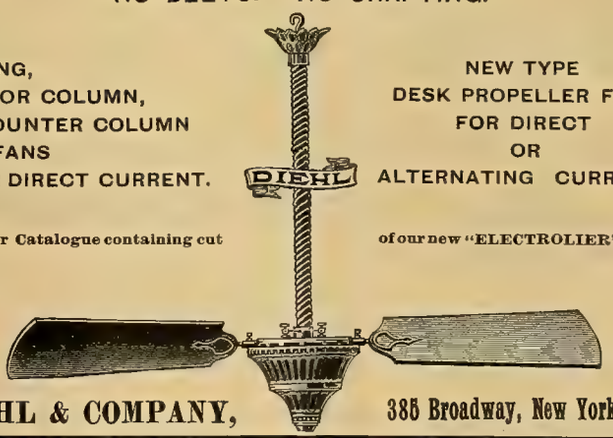
FANS
FOR DIRECT CURRENT.

NEW TYPE
DESK PROPELLER FANS
FOR DIRECT
OR
ALTERNATING CURRENT.



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DIEHL & COMPANY, 385 Broadway, New York City.

THEY ARE IN STOCK. SEND US A SAMPLE ORDER.

Radial Fluted.

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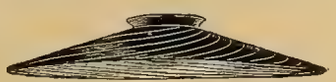
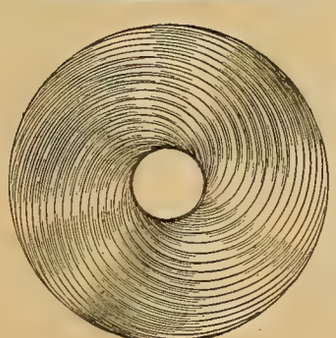
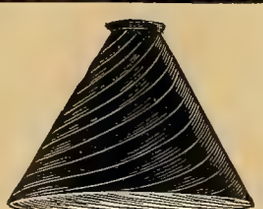
17 in. diameter,	2¼ in. holder,	$ 9.00
8 " "	2¼ " "	10.00
0 " "	2¼ " "	12.00

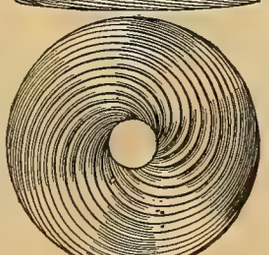




Flat Spiral Corrugated.

		PER DOZEN
8 in. diameter,	2¼ in. holder,	$ 8.00
10 " "	2¼ " "	9.00





Deep Spiral Corrugated.

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7 in. diameter,	2¼ in. holder,	$ 8.00
10 " "	2¼ " "	12.00

GLEASON'S STANDARD ELECTRIC SILVER GLASS REFLECTORS.

Enameled Green Outside, Silvered Inside.

The simplest, cheapest and best Reflectors for increasing candle power of incandescent lamps.
Made in all staple sizes of electric shades.
Always bright; cannot tarnish.

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And that seasonable specialty, the

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EVERYTHING DESIRABLE

In the Electrical Supply Line.

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WIRT DYNAMO BRUSH,

For Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.

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Cleats, 2 or 3 wire, glazed, **$30.** per 1,000
Insulators, " **12.** " "
Rosettes, fuseless, " **6.** " 100

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ENGINEERS,
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For under ground, under water, and all other conditions.

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GENUINE HARD PORCELAIN, CUT-OUTS, SWITCH BASES, INSULATORS &c

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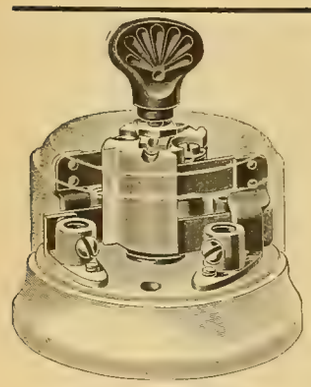

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THOS. G. GRIER, EDWARD R. GRIER, Western Representatives.

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Important to Lighting Stations!

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ALTERNATING CURRENT INDICATORS

Are now ready. Before purchasing elsewhere send for our Supplementary Catalogue which contains the prices and description of the above instruments, and also a list and prices of other *new instruments* of our manufacture.

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EUGENE F. PHILLIPS, Prest. W. A. HATHAWAY, Treas. W. H. SAWYER, Sec'y.

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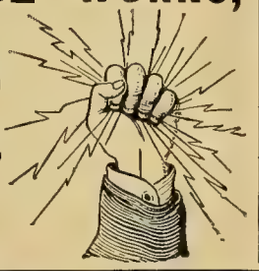
ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. **WIRES.**



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MONTREAL BRANCH, Eugene F. Phillips' Electrical Works

ESTABLISHED 1848.

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OFFICE, COVINGTON, KY. FACTORIES, MUNCIE, IND.

Standard Screw Glass Insulators, Floor Insulators, Glass Break Knobs, Battery Jars, Arc Light Globes for All Systems, Colored Glass Insulators, to designate different currents.

WORK ON SPECIAL DESIGNS A FEATURE.

Send Model or Drawing and we will furnish estimates.

THE

"CLARK" WIRE.

TRADE MARK.

For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

Western Agents,

GREAT WESTERN MFG. CO.,

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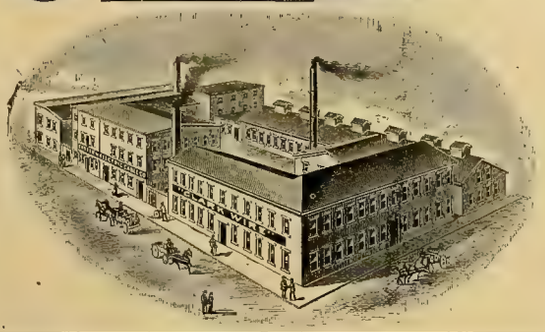

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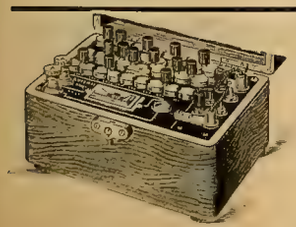

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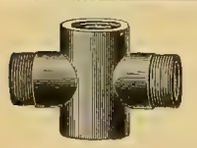

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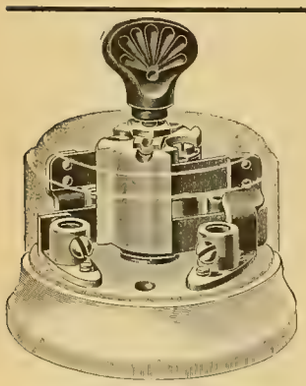

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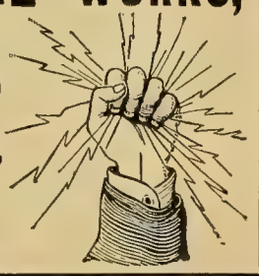

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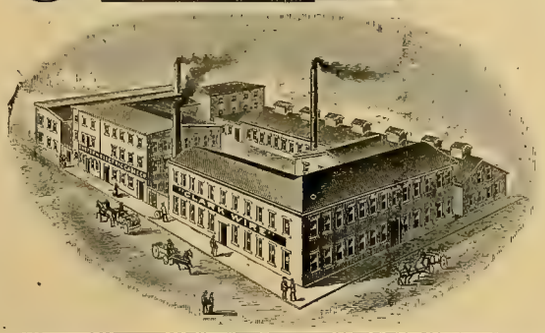

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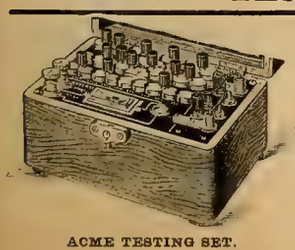

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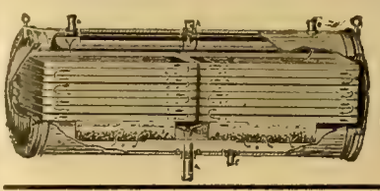

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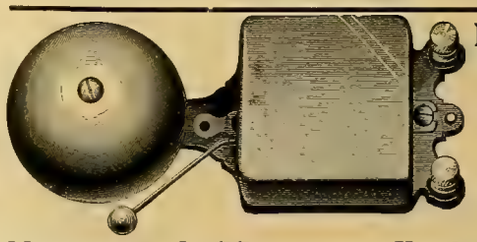

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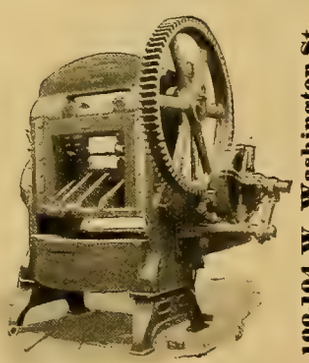

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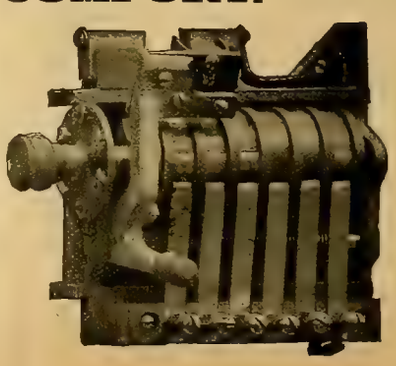

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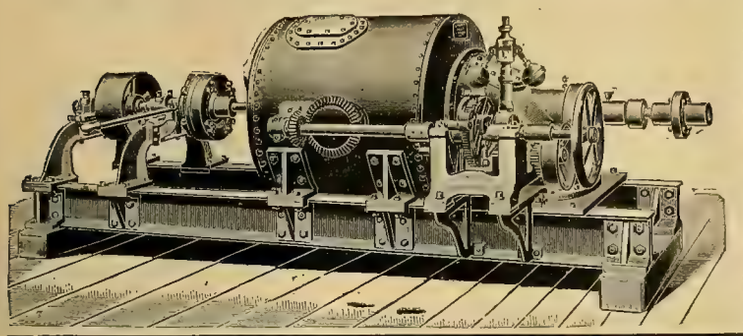

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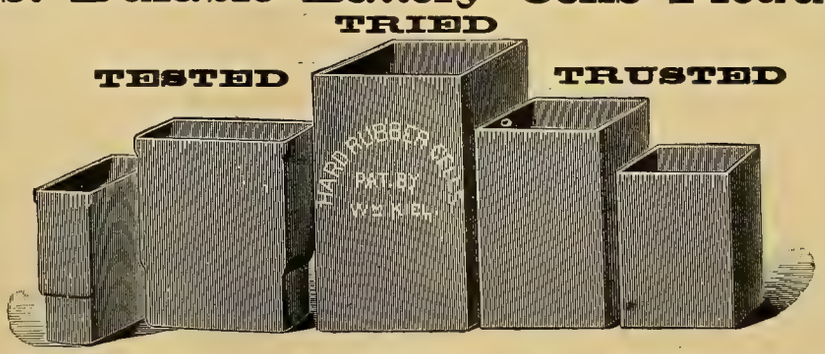

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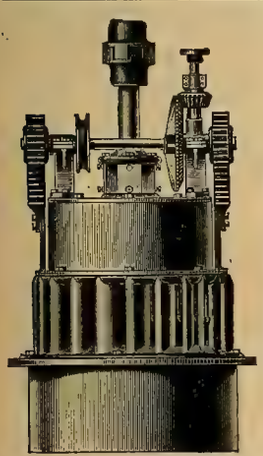

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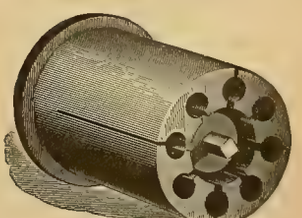

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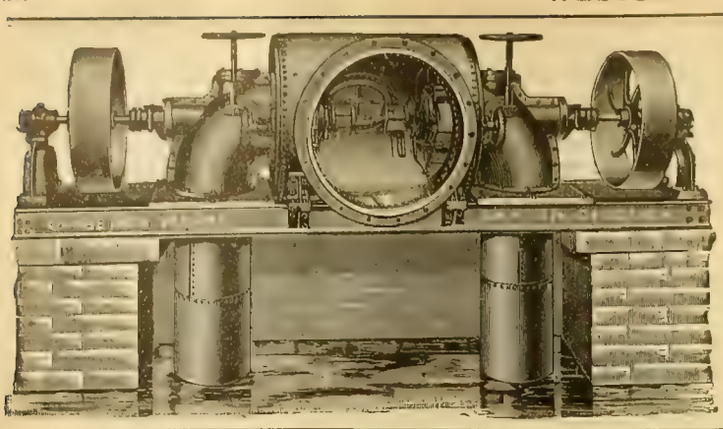

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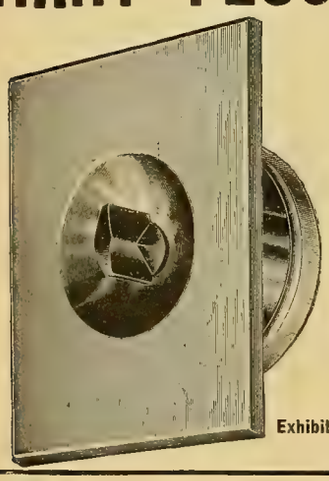

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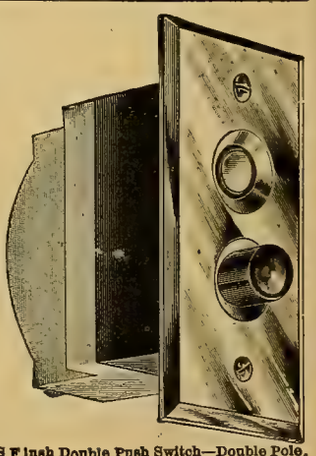

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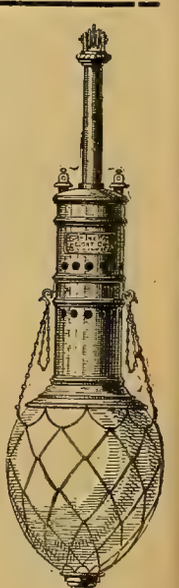

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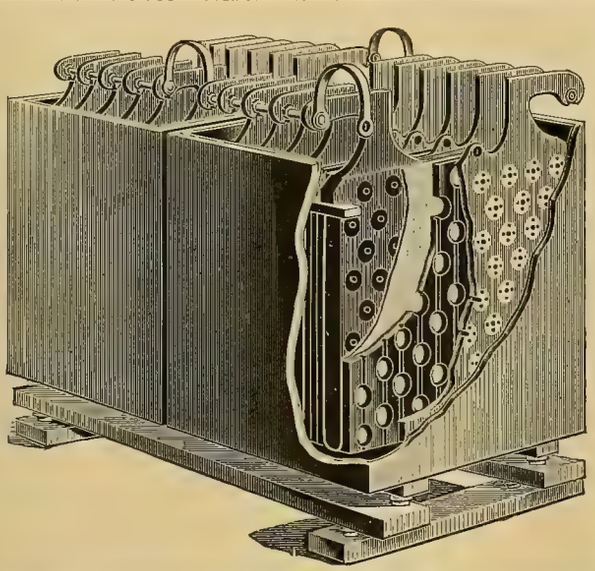

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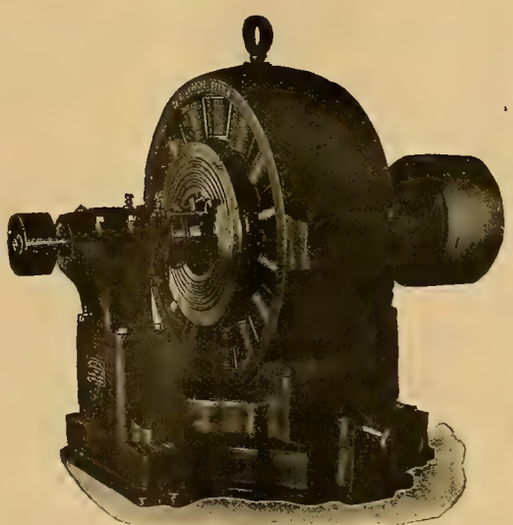

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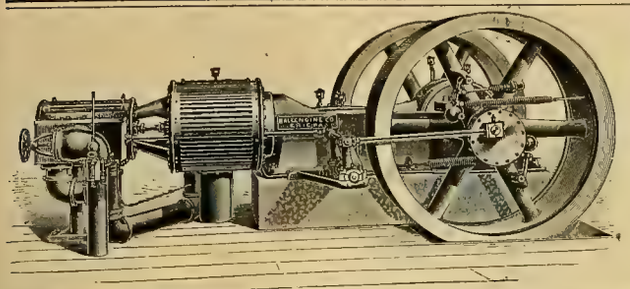

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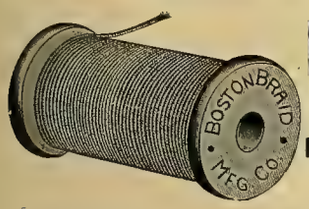

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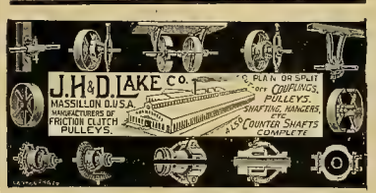

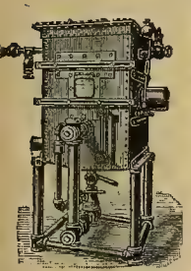

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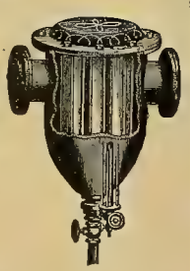

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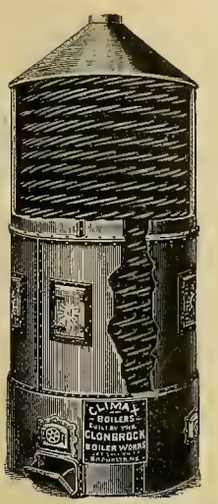

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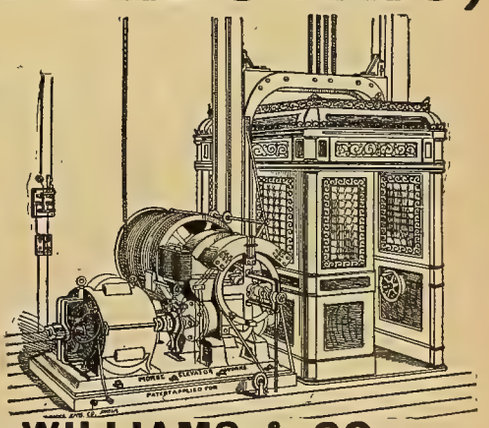

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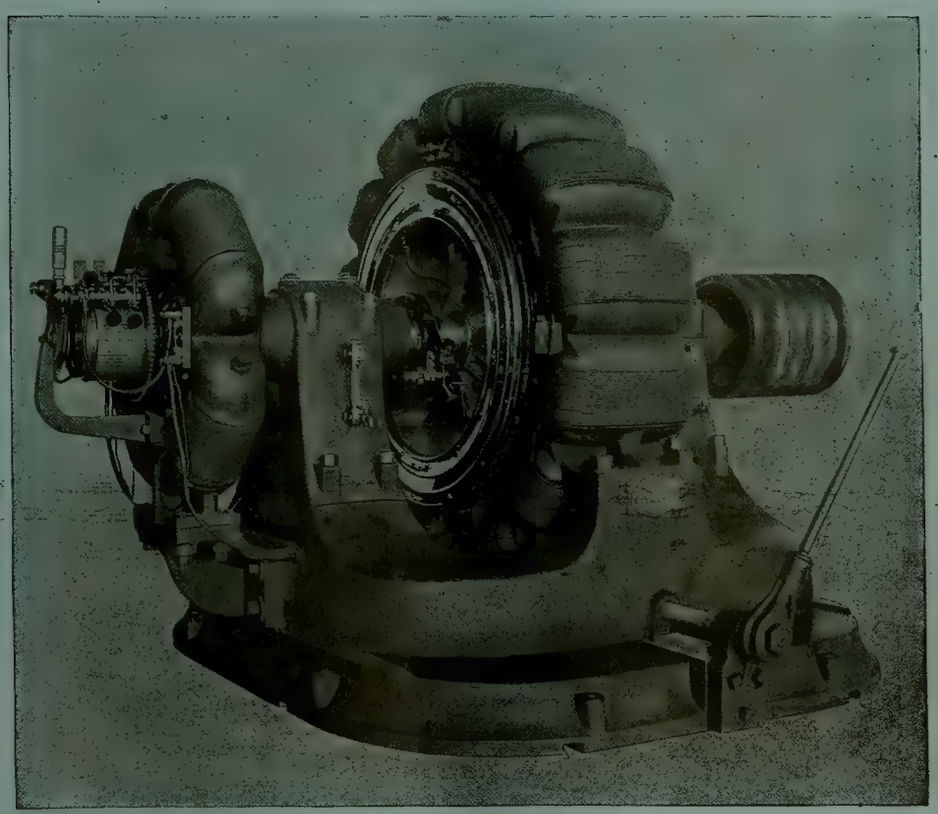

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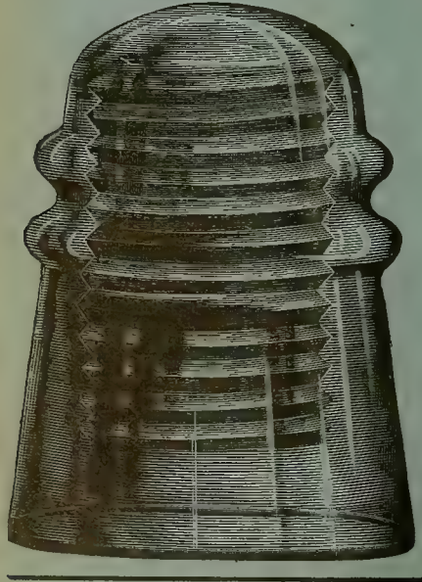

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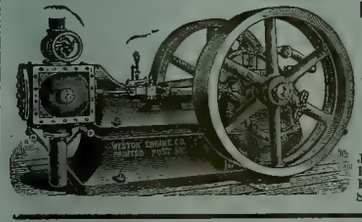

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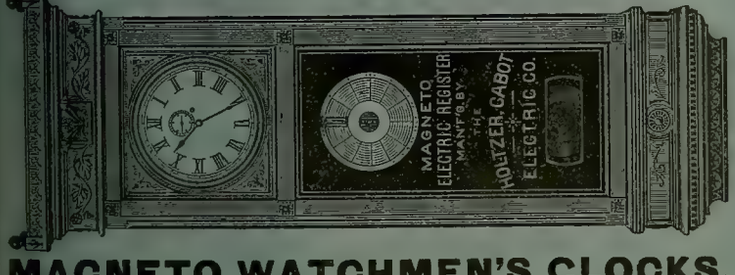

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Electric Cons. & Supply Co.
Fort Wayne Electric Co.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Royal Arc Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Standard Electric Co.
Taylor, Dee & Mack.
Westinghouse El. & Mfg. Co.

Arc Light Cord.
Central Electric Co.
Electric Appliance Co.

Armature Winders.
Rushmore, S. W.
Stanwood M'f'g Co.

Batteries and Jars.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Carter & Co., Geo. G.
Central Electric Co.
Columbia Rubber Wks. Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Peru Electric Mfg. Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Bells.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E.S.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Belting.
Columbia Rubber Wks. Co.
Shultz Belting Co.

Bicycles
Ames & Frost Co.

Boilers.
Babcock & Wilcox Co., The.
Clonbrock Steam Boiler Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Link Belt Machinery Co.
Racine Hardware Co.
Stirling Co., The.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Brushes, Dynamo and Motor.
Partridge Carbon Co.
Wirt, Chas.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Cables (See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Carter & Co., Geo. G.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Hill, W. S. Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Taylor, Dee & Mack.
Western Electric Co.

Carbons, Points & Plates.
Central Electric Co.
General Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co.
Partridge Carbon Co.
Western Electric Co.

Car-Heaters, Electric.
Consolidated Car-Heating Co.

Clutches, Friction.
Lake, J. H. & D. Co.
Link Belt Machinery Co.

Conduits.
Fibre Conduit Co., The.

Construction & Repairs.
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Johnson, Montgomery H.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Osburn, Harry G.
Rushmore, S. W.
Stone, O. M.
Wirt, Chas.

Contractors and Electric Light Plants.
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Carter & Co., Geo. G.
Clark Electric Co.
Colburn Electric Mfg. Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Fort Wayne Electric Co.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Siemens & Halske Elec. Co.
Stone, O. M.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

Copper.
Law Battery Co.
Miamisburg Electric Co.

Copper Wires.
American Electrical Works.
Bernard Co., The E. G.
Bishop Gutta Percha Co.
Bunnell & Co , J. H.
Carter & Co., Geo. G.
Central Electric Co.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

Cross-Arms, Pins and Brackets.
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
Taylor, Dee & Mack.

Cut-Outs and Switches.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Carter & Co., Geo G.
Central Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Huebel & Manger.
Little, F. P. Elec. C. & S. Co.
Manhattan Elec. Sup. Co.
Metropolitan Electric Co.
Perkins Elec. Switch Mfg. Co.
Sioux City E. S. Co.
Taylor, Dee & Mack.
Western Elec. Supply Co.

Desk Lights.
Cooke, E. D.

Dynamos.
Brush Electric Co.
C. & C. Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Fort Wayne Electric Co.
General Electric Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Rose Elec. Light Supply Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Electric Railways.
Brush Electric Co
General Electric Co.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Johnson, Montgomery H.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Stone, O. M.
Wirt, Chas.

Electrical Instruments.
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Queen & Company, Incorp.
Taylor, Dee & Mack.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.
Wirt, Chas.

Electrical Specialties.
Cooke, E. D.
Electric Appliance Co.
General Electric Co.
Holtzer-Cabot Electric Co.

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Independent Electric Co.
Taylor, Dee & Mack.

Electrolliers, etc.
Baggot, E.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

Electro-Plating Mach'y.
Colburn Electric Mfg. Co.
General Electric Co.

Engines, Steam.
Ball & Wood Co., The.
Ball Engine Co.
Brownell & Co., The.
Freeman Sons Mfg. Co.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Toomey, Frank.
Weston Engine Co.

Elevators, Electric.
Morse, Williams & Co.

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Diehl & Co.
Central Electric Co.

Fibre.
American Hard Fibre Co.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
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Butler Hard Rubber Co.
Columbia Rubber Wks. Co.
Western Electric Co.

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Electric Appliance Co.
General Electric Co.
Independent Electric Co.

Gas Lighting, Electric.
American Electric Co.
Holtzer-Cabot Electric Co.

Gears.
General Electric Co.
Grant, Geo. B.

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Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Carter & Co., Geo. G.
Central Electric Co.
Colburn Electric Mfg. Co.
Cooke, E. D.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Law Battery Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Palmer Bros.
Peru Electric Mfg. Co.
Queen & Co., Incorp.
Rushmore, S. W.
Sioux City Elec. Supply Co.
Taylor, Dee & Mack.
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Gleason E. P. Mfg. Co.
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Hemingray Glass Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co
Metropolitan Electric Co.
Moore, Alfred F.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Peru Electric Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Taylor, Dee & Mack.
Vulcanized Fibre Co.
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Bunnell & Co., J. H.
Carter & Co., Geo. G.
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Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Taylor, Dee & Mack.
Western Electric Co.
Western Elec. Supply Co.

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Cooke, E. D.

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Beacon Vacuum Pump & Electrical Co.
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Buckeye Electric Co
Carter & Co., Geo. G.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Lasell & Co., Edw.
Mather Electric Co.
Metropolitan Electric Co.
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Taylor, Dee & Mack.
Westinghouse Elec. & Mfg. Co.

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Central Electric Co.
Electric Appliance Co.
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Hill, W. S. Electric Co.
Wirt, Chas.

Magnet Wire.
(See Insulated Wires.)

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Mica.
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Taylor, Dee & Mack.
Westinghouse El. & Mfg. Co.

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Standard Paint Co.

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Phosphor Bronze Sm.Co. Ltd

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Brownlee & Co.

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Empire China Works.
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Worthington, Henry R.

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Consolidated Car-Heating Co

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Brill, J. G. Co.

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Cushing & Morse.
Chicago Ins. Wire Co.
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Metropolitan Electric Co.
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New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Paint Co.
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Electric Appliance Co.
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Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

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D'Unger Long Dist. Tel. Co.
Harrison Int. Telephone Co
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Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co
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New Prices given on Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters

And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.

This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.

OUR SERIES LAMPS

Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.

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The United Electric Improvement Co.,

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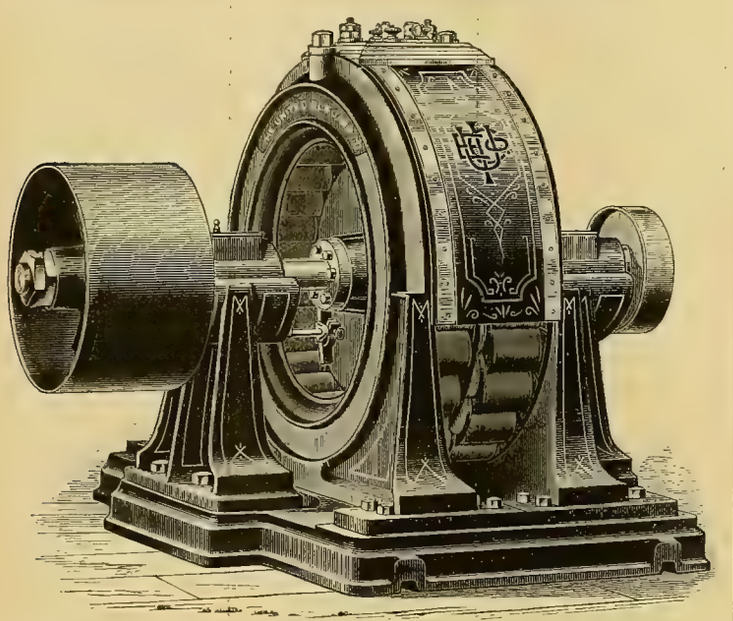
Desires to correspond with responsible parties actively engaged in the sale of electric lighting apparatus in the following cities, viz.:



New York, New Orleans, St. Paul, Montreal, *San Francisco, Cincinnati, Galveston, Salt Lake City, Jacksonville.* *Omaha, Boston. Atlanta, Denver,* *Seattle, Los Angeles, Baltimore, San Antonio*

To those desirous of taking up the sale of Alternating Current Apparatus of undoubted merit, an opportunity is offered.

THE HELIOS LAMP FOR STREET LIGHTING.

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Helios Electric Co.

Philadelphia Penn'a

Gentlemen:

In regard to the Helios Lamps we have in use on our Direct-Circuit will say, We now have 26. 2000 C.P. Helios Lamps running on our streets and giving good satisfaction. The first installation of 17 Lamps was made subject to acceptance by the City Council, and before they would accept the lights they had an Expert test and report made. The Lamps was sustained as to Candle Power and General efficency, & the result was an order for 8 more Lights by the City and 1 by the County on Court House Grounds. They give a very clear steady white light, entirely free from the flaking and leaping out of the ordinary Direct Current arc Lamp.

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HELIOS ELECTRIC CO., 1310 Filbert St., Philadelphia.

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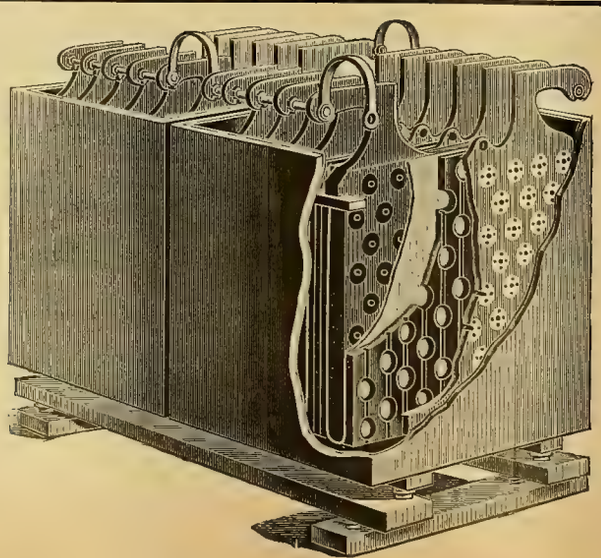
Southwestern Agents: ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis, Mo.
Canadian Agency: CANADIAN GENERAL ELECTRIC CO., Toronto, Canada.



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Cells from 10 to 5,000 amp. hours Capacity.

Central Station and Traction Cells a Specialty.

BATTERIES FOR ISOLATED LIGHTING AND POWER PLANTS.

Catalogue gives FACTS and FIGURES.

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The CENTRAL ELECTRIC Co.

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OKONITE TRADE MARK

THE BEST APPOINTED AND LARGEST ELECTRICAL SUPPLY HOUSE IN THE WORLD.

"Jess' sure's I start out t'have a roarin hot time of it—thatsh fellow Lundell comes 'round—he—he—hash such a **depressing** 'fect on **me!**"

He's wurs in' ice-man!

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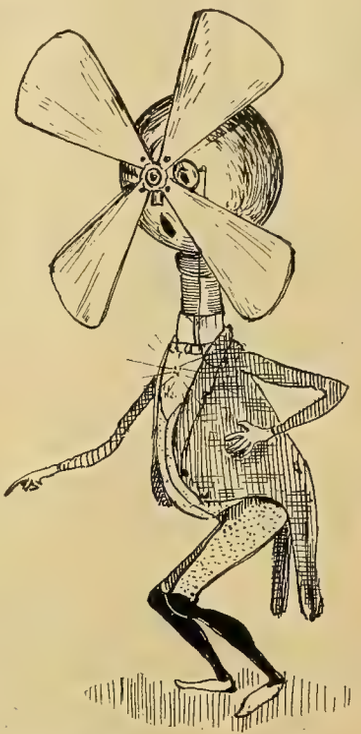
Starts out with a pretty good showing for May—getting his spirits up near the nineties—hottest May-day in 20 years—there's no telling how he'll bob up in June, July, August, and September. The safest thing to do is to fix for the unexpected.



Get your assortment now—

Ceiling fans, desk fans, bracket fans. Have them shipped by freight—**save express charges**—because one of these hot days about every other restaurant or drug store in town will ring up—

> "Hello, 'ello, that you Hustler? well how soon can you put in one of those fan-moters? this is simply awful! whew! well, rush it in quick before we melt! And, say—hello!—say, will it keep the flies off?"

And don't forget, that if you know of some invalid, burning up with a fever, and you haven't got a circuit down that way, a Lundell fan-motor with an Edison-Leland battery, will do more than half the medicine—make a cool fresh breeze; comforting, grateful, life-saving. We can supply anything you want, and send them quick, but order **now**—freight is cheapest.

THE·CENTRAL·ELECTRIC·Co

173~175 ADAMS STREET

CHICAGO

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OKONITE WIRES,
HELIOS ARC LAMPS,
INTERIOR CONDUITS,
WASHINGTON CARBONS.

How about that poem in last week's issue?

If you are contemplating the purchase of **Alternating Apparatus**, get

TWO-PHASE GENERATORS

which will cost no more than single phase. You can then operate lights as economically and as satisfactorily as from single phase generators, and in addition use

ALTERNATING CURRENT MOTORS,

which we are now building in 1, 2, 3, 5, 7, 10 and 15 Horse Power sizes. Our standard

TRANSFORMERS

For lighting purposes are carried in stock, and orders can be filled promptly.

The most economical and easiest handled transformer on the market. Special transformers for any desired voltage. Special transformers for arc lighting.

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PITTSFIELD, MASS.

Selling Agents for the Helios Arc Lamps in New England and New York State.

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Don't make a Alternating Arc investigating

By Buying any Lamp before the

MON-ARC

Everything about it is of the very best. Brass Frame, Brass Shell, Brass Cap, Brass Rods. No tin or stovepipe iron. It combines unequaled simplicity with absence of all objectionable features heretofore present in alternating lamps. It is a **NON-STICKER** that central station men and lamp trimmers will be **STUCK** on because they don't have to **MONKEY** with it every few days, taking it down to clean and oil. Lamps for all systems. We guarantee every lamp. Write for prices.

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Engineers—Founders—Machinists,

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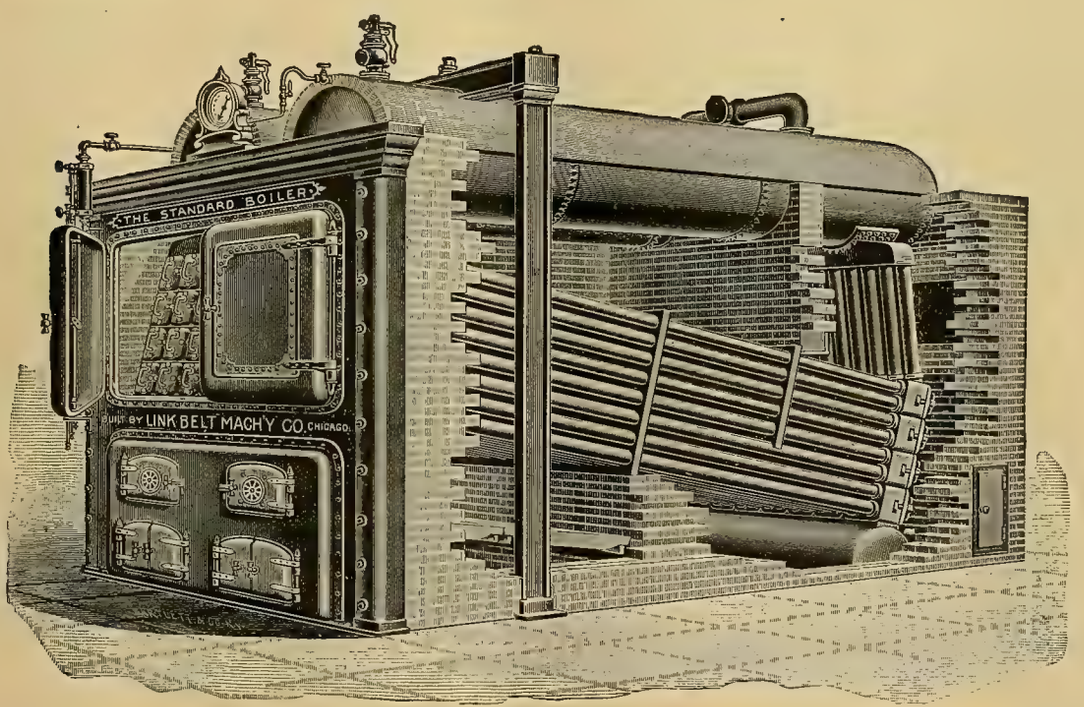
Manufacture The Caldwell

Standard Water Tube Safety Boiler.

ABSOLUTE SAFETY WITH



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THE LINK-BELT COMPANIES,

Link-Belt Machinery Co., Chicago.
Link-Belt Engineering Co., Philadelphia and New York.

DESIGNERS AND BUILDERS OF

Machinery for Handling Coal and Ashes.

We have equipped the power plants of the following well-known firms with machinery for handling coal from cars, barges and wagons to boilers, and for taking ashes from under boilers to dump:

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New York Steam Heating Co., New York.
Washburn & Moen Mfg. Co., Waukegan, Ill.
Spreckles Sugar Refining Co., Philadelphia, Pa.
Illinois Steel Co., Joliet, Ill.
Illinois Steel Co., South Chicago, Ill.
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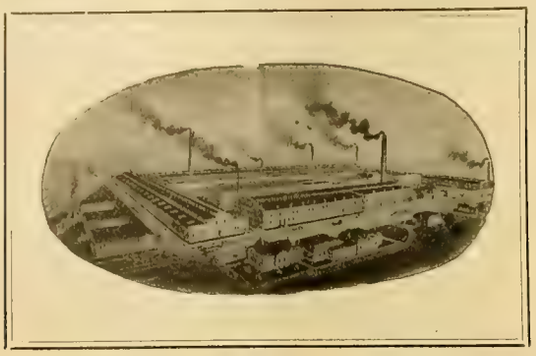
P. Schoenhofen Brewing Co., Chicago.
Pabst Brewing Co., Milwaukee, Wis.
Franklin Sugar Refining Co., Philadelphia, Pa.
Anglo-American Packing & Provision Co., Union Stock Yards, Chicago, and many others.

Electric Lighting and Power Apparatus



The Brush Double Arc Lamp Patents sustained by repeated decisions of U. S. Courts.

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Agencies in all large cities.
The Russell & Officer Electrical Construction Co., Denver, Col.
Bagnall and Hilles, Yokohoma, Japan.

Office and Works, Cor. Belden and Mason Sts., CLEVELAND, OHIO.

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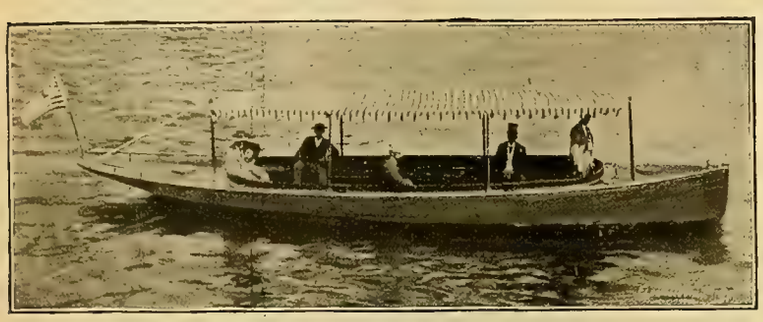

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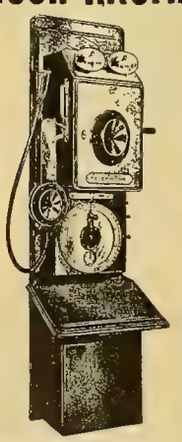

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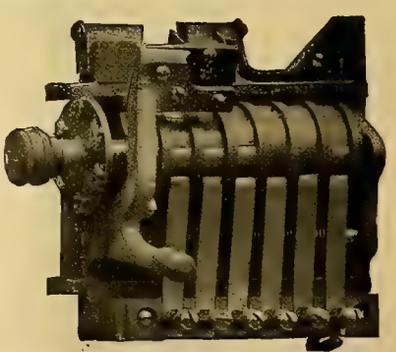

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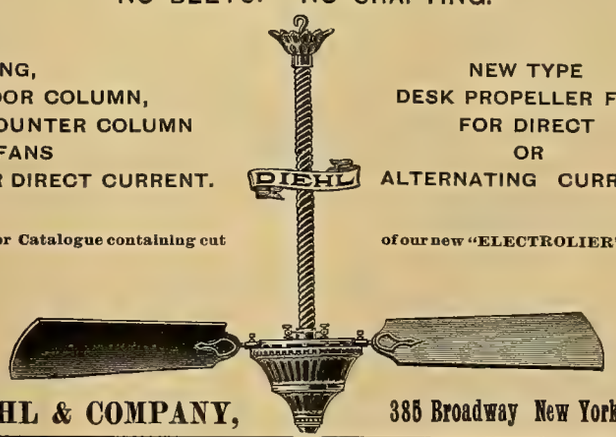

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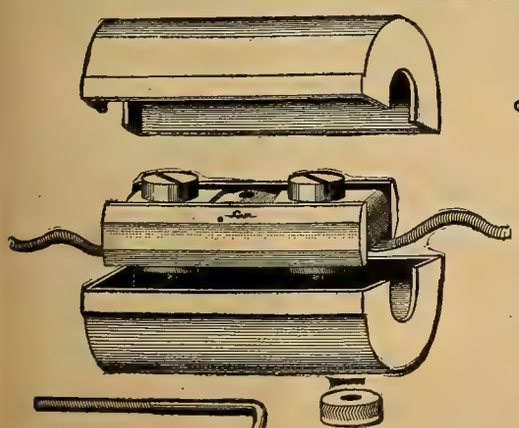

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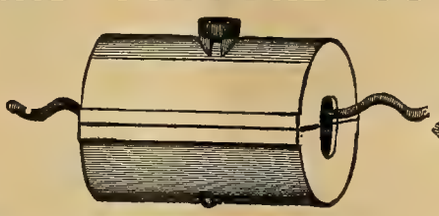

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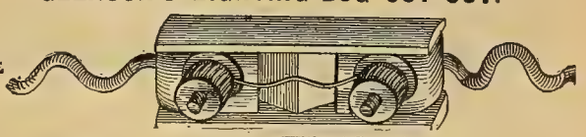

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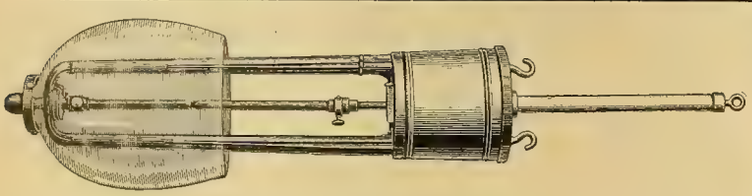

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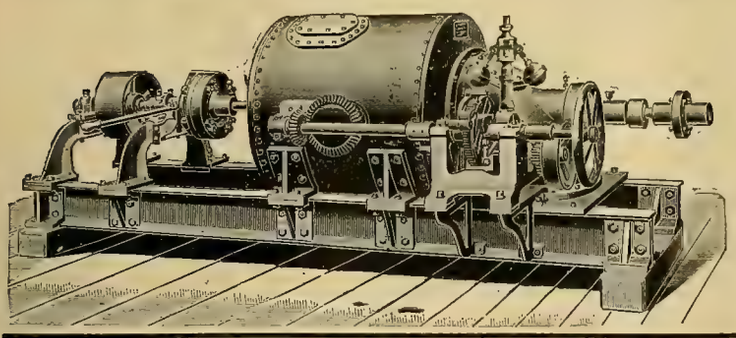

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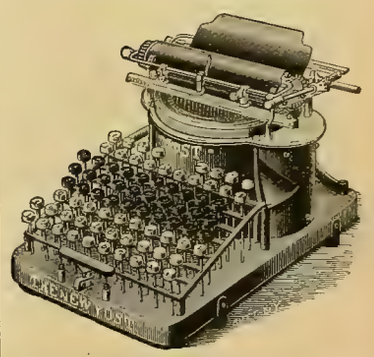

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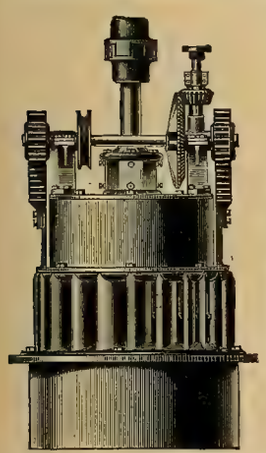

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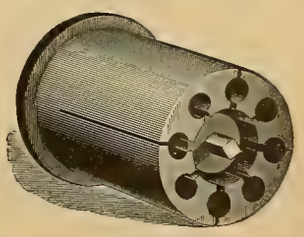

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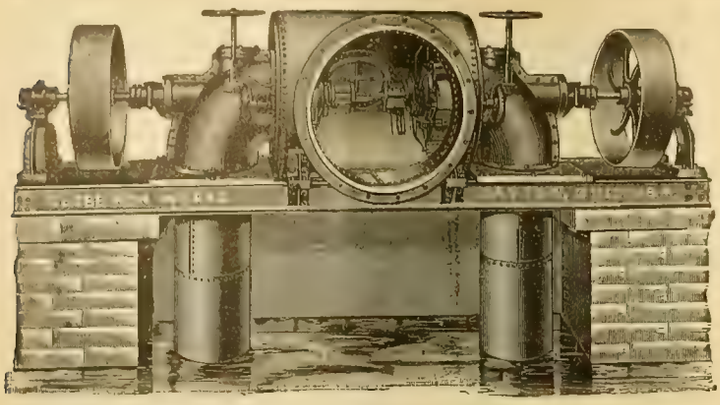

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CHAPTER 8....Single Circuit, Self-Starting Synchronizing Motors.
CHAPTER 9....Change from Double Current to Single Current Motor.
CHAPTER 10....Motor with "Current Lag" Artificially Secured.
CHAPTER 11 ...Another Method of Transformation from a Torque to a Synchronizing Motor.
CHAPTER 12....."Magnetic Lag" Motor.
CHAPTER 13 ...Method of Obtaining Difference of Phase by Magnetic Shielding.
CHAPTER 14....Type of Tesla Single-Phase Motor.
CHAPTER 15....Motors with Circuits of Different Resistance.
CHAPTER 16....Motor with Equal Magnetic Energies in Field and Armature.
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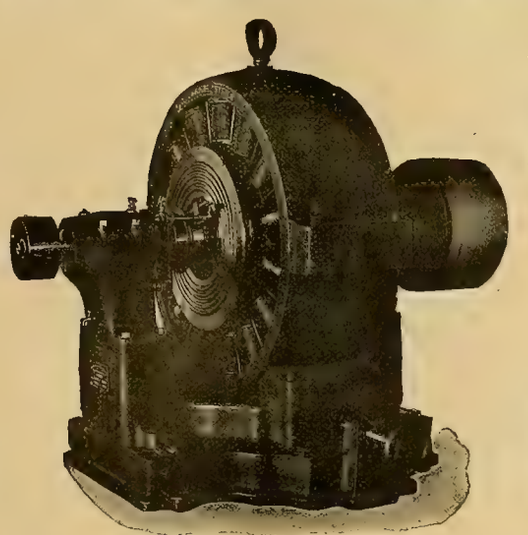

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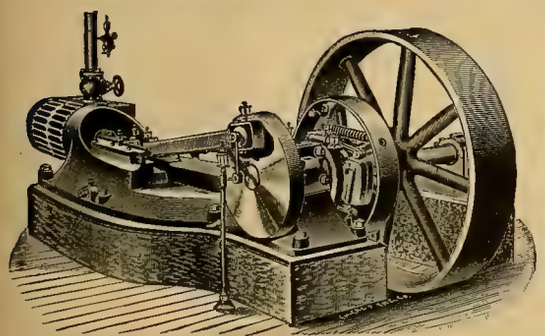

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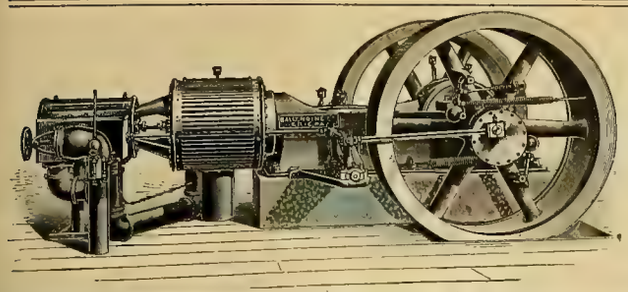

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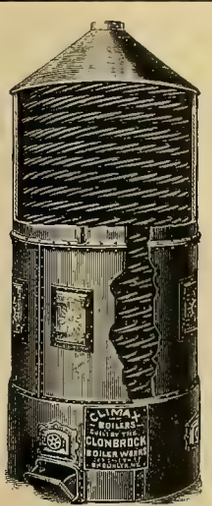

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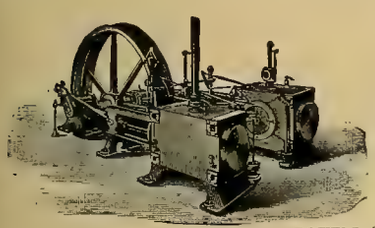

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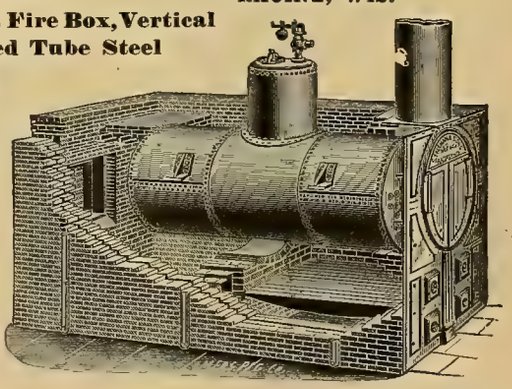

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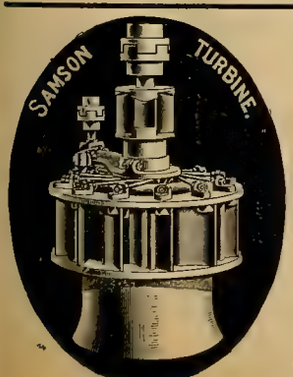

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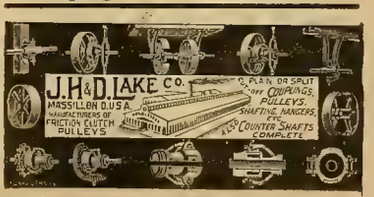

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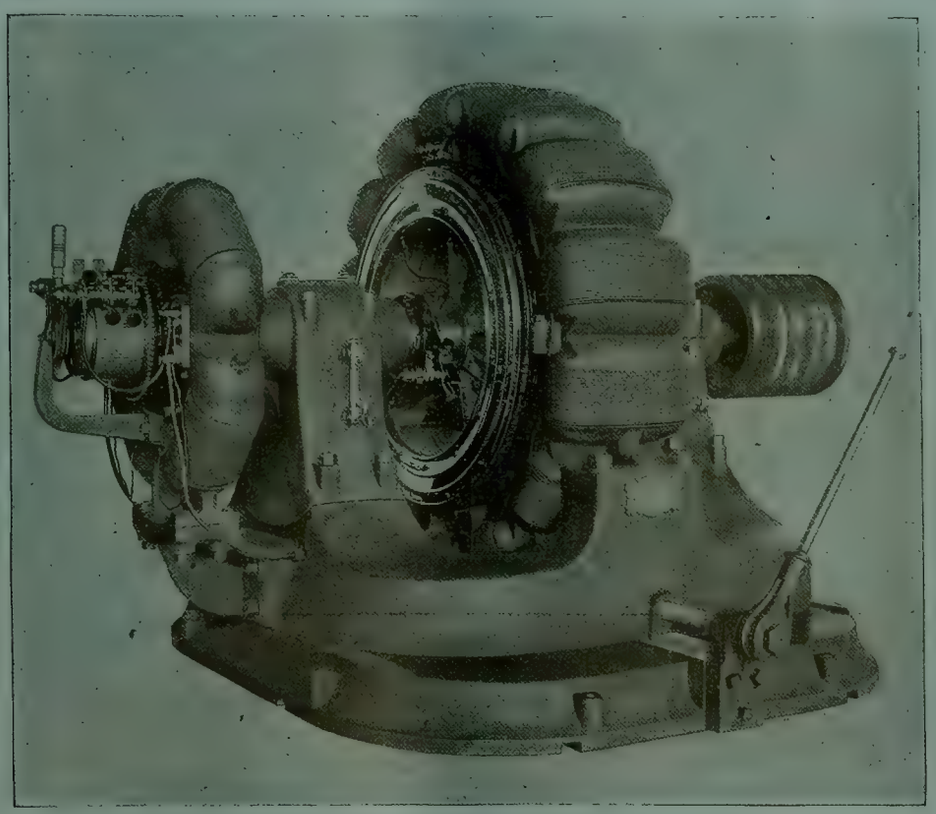

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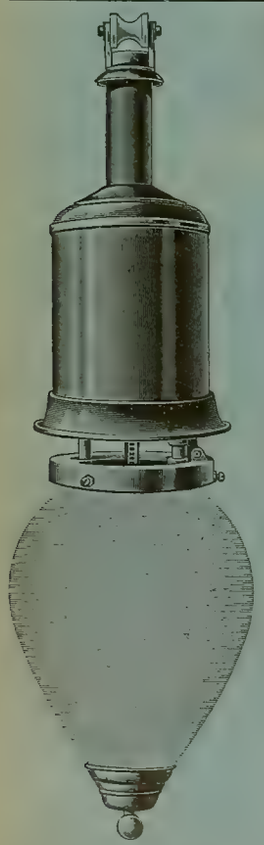

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Vol. XIV. CHICAGO, JUNE 2, 1894. No. 22

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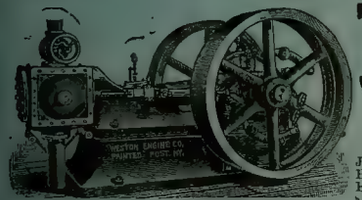

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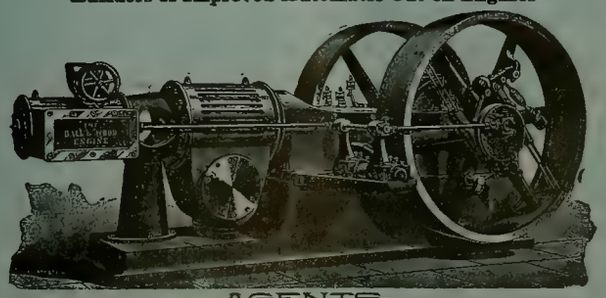

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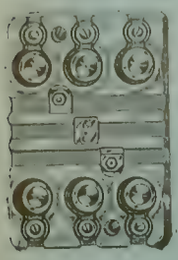

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Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hammond Cleat & Ins. Co.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Law Battery Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Palmer Bros.
Peru Electric Mfg. Co.
Queen & Co., Incorp.
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Sioux City Brass Works.
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Gleason E. P. Mfg. Co.
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Munsell & Co.. Eugene.
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Okonite Co., The.
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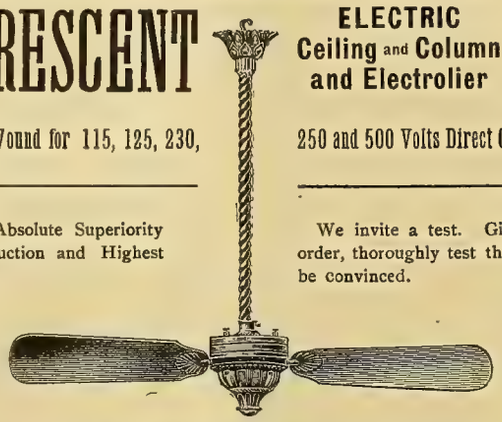

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Gentlemen:-

We are in receipt of your inquiry regarding your Alternating Arc Lamps; would say, they are just simply perfection. We now have 14 in use and work to our entire satisfaction in every respect; the light is absolutely steady and the only arc Lamp that I ever saw that gives a perfect steady light. It has been said that there could not be an arc lamp made to work on the Alternating current and do good work, but you have struck it, and I have got to hear the first word spoken against it, and in my opinion the Direct Current Lamp has seen its day.

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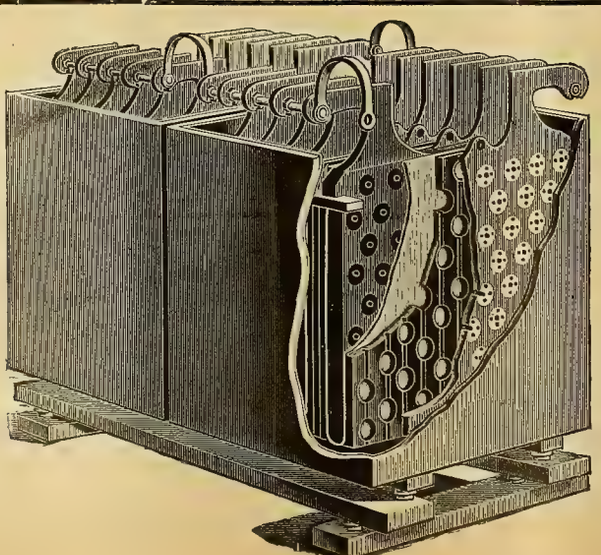

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Of the Lundell Fan Motor will result in just one way—Orders.

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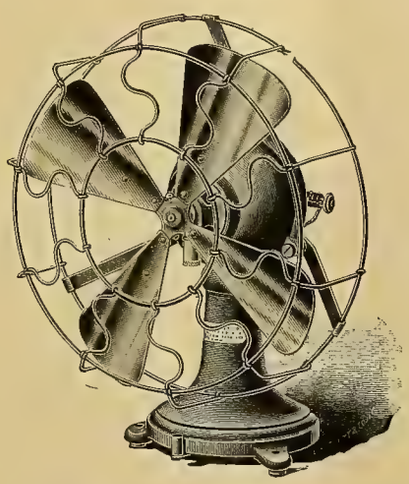

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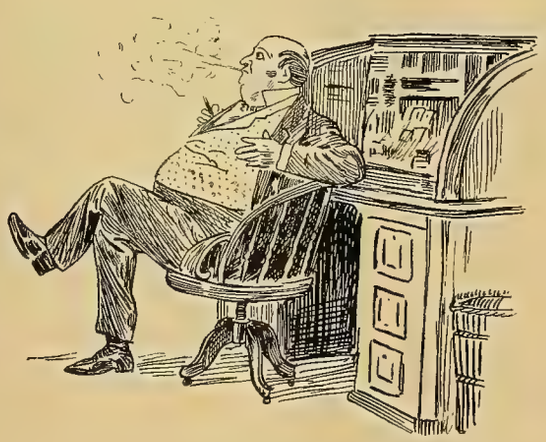

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Don't make a Alternating Arc investigating

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Everything about it is of the very best. Brass Frame, Brass Shell, Brass Cap, Brass Rods. No tin or stovepipe iron. It combines unequaled simplicity with absence of all objectionable features heretofore present in alternating lamps. It is a **NON-STICKER** that central station men and lamp trimmers will be **STUCK** on because they don't have to **MONKEY** with it every few days, taking it down to clean and oil. Lamps for all systems. We guarantee every lamp. Write for prices.

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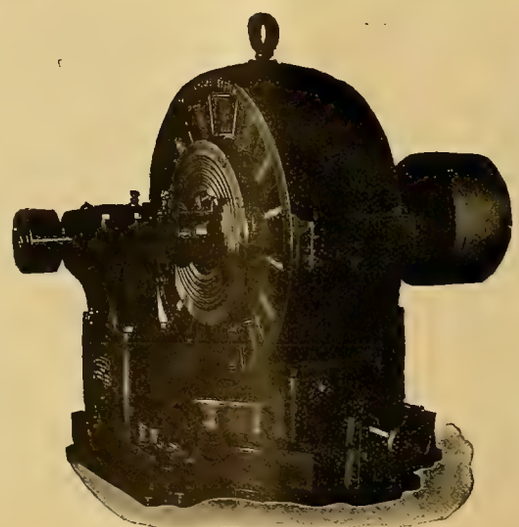

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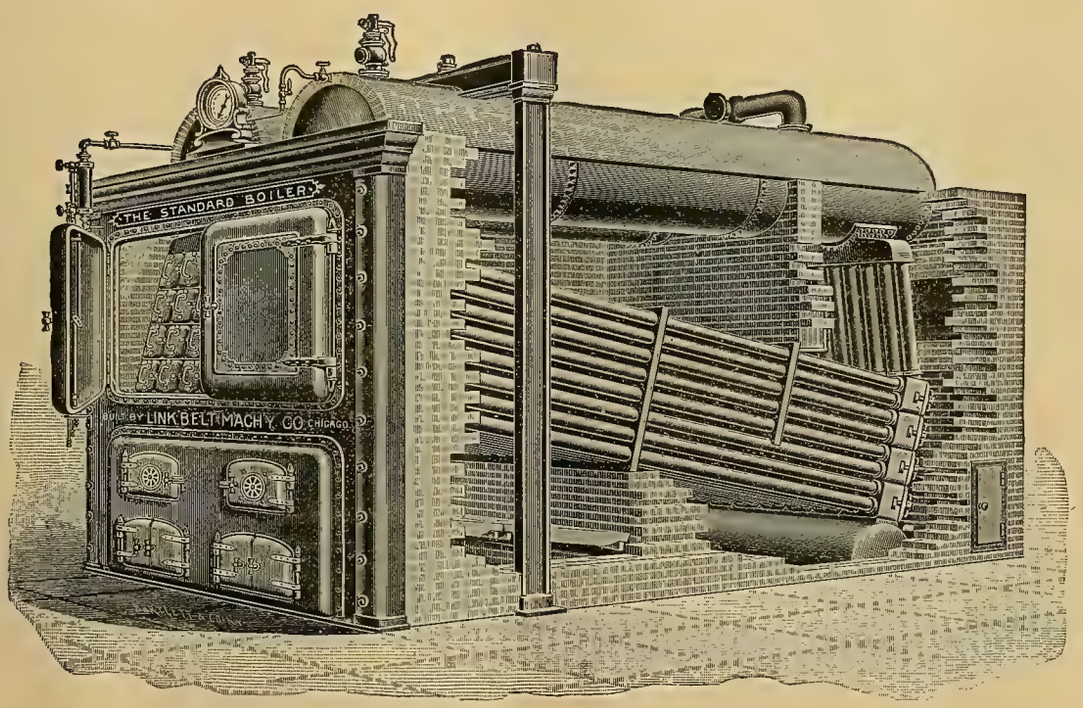

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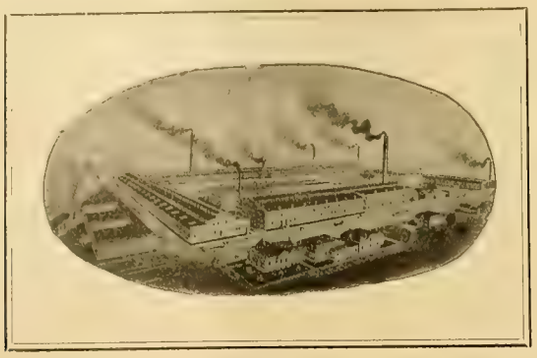

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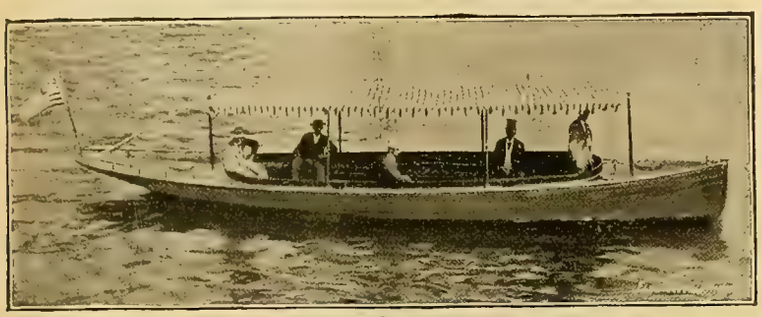

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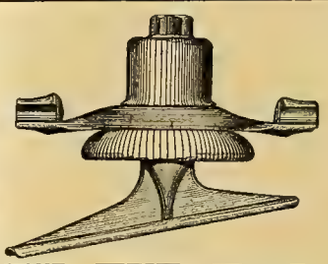

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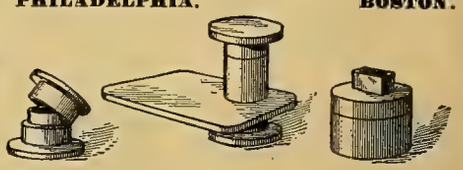

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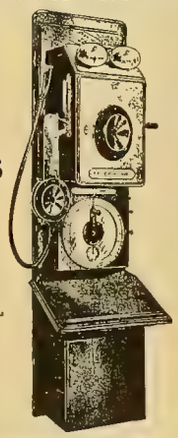

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This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

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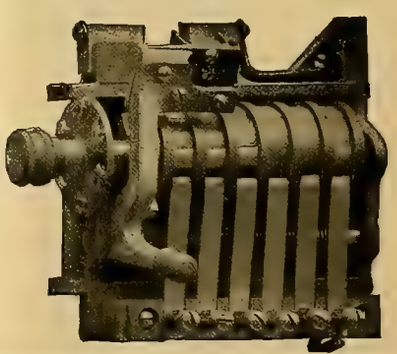

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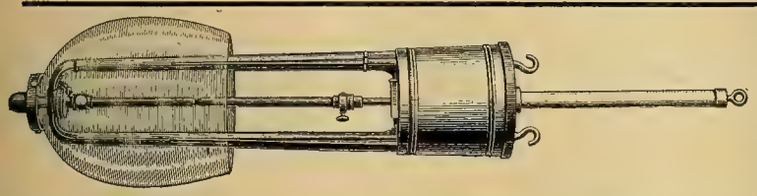

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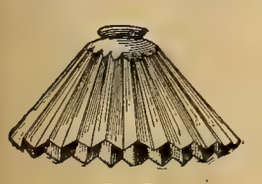

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17 in. diameter,	2¼ in. holder,	$ 9.00
8 " "	2¼ " "	10.00
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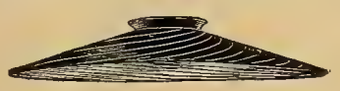

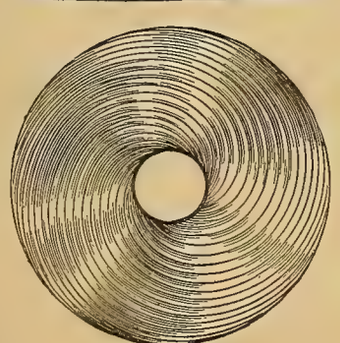

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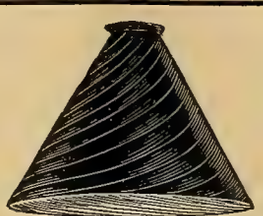
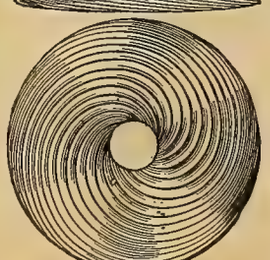
8 in. diameter,	2¼ in. holder,	$ 8.00
10 " "	2¼ " "	9.00





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7 in. diameter,	2¼ in. holder,	$ 8.00
10 " "	2¼ " "	12.00

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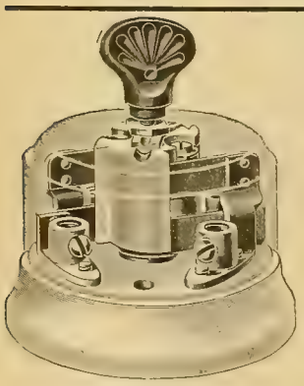

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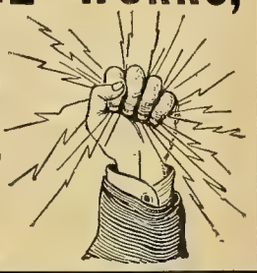

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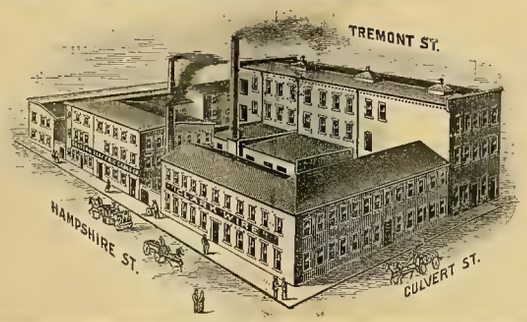

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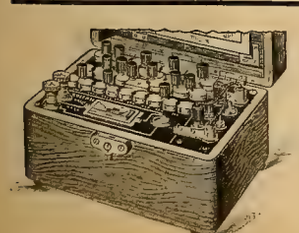

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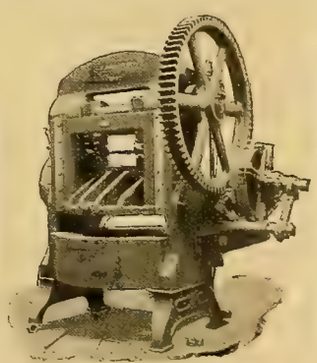

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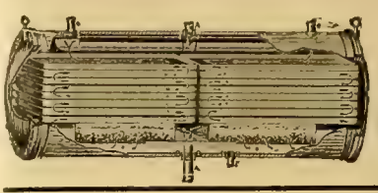

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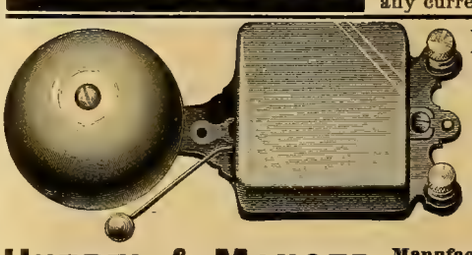
ELECTRIC CO., 192 Broadway, New York,

Is the only concern in the world that makes

Arc Lighting

Apparatus for every purpose, and for use on every current.

Our Arc Lamps can be used on any current whatever.



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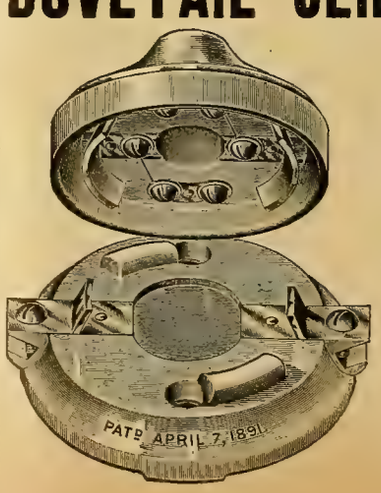

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Requires no screw driver to detach cap.
Makes perfect contact.

Neat in appearance and well made.

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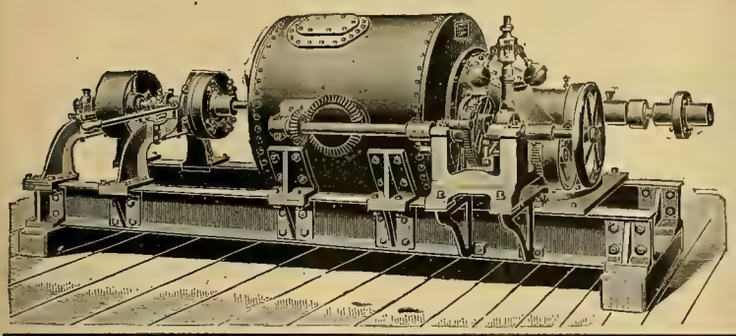
VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high speed and great Efficiency,** and **Large Capacity** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect **guaranteed.** **SEND FOR CATALOGUE AND PARTICULARS.**

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The accompanying engraving represents a pair of of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast Iron Flume, Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - Dayton, Ohio.

HAMLET

ACT V. SCENE I.

Hamlet. Why, I will fight with him upon this theme Until my eyelids will no longer way.

The theme referred to by "Ham" was the Law Double Cylinder cell, and the party he was seeking to get on a match with was, of course, imaginary. The meaning he intended to convey to the Queen was that if perchance anyone should venture to say anything against the good qualities of this Cell, that he would Then set his eyelids wagging.

Well, he was right in taking this position, for it cannot be denied that the Law Double Cylinder cell is the standard open circuit cell of the World, for it embodies all the qualities that should go to make up such a cell, namely:

High E. M. F.,
Uniformity of Current,
Cleanliness,
Low Internal Resistance,
Great Holding-up Power,
Cheapness.

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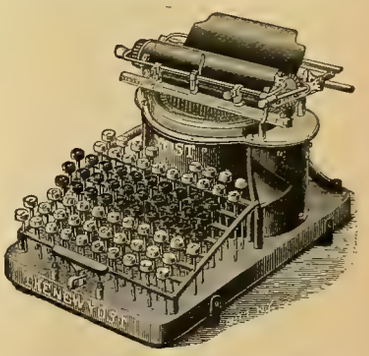

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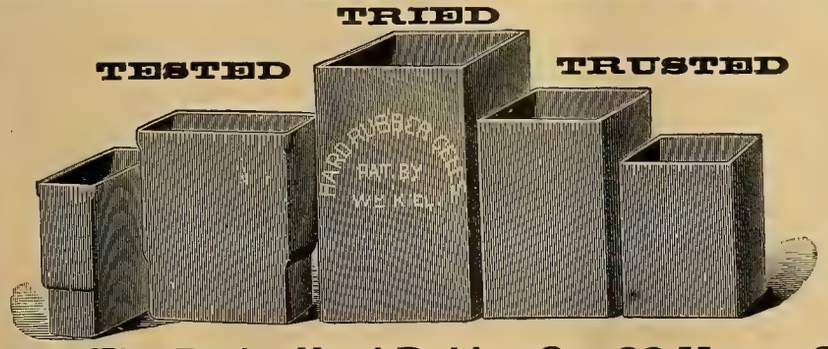

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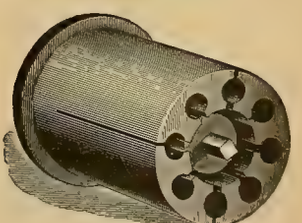

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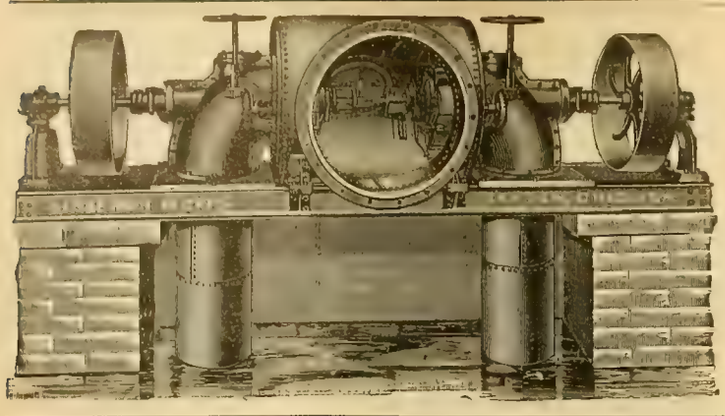

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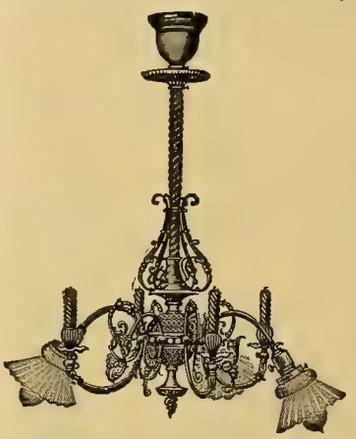

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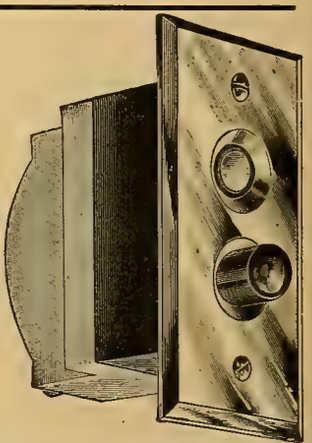

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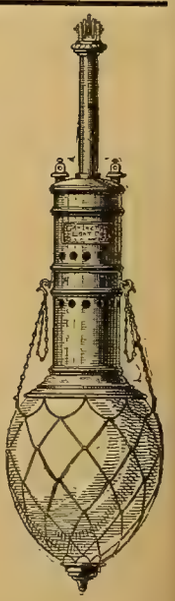

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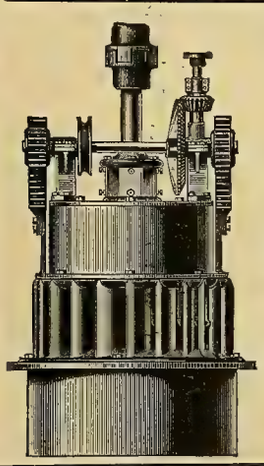

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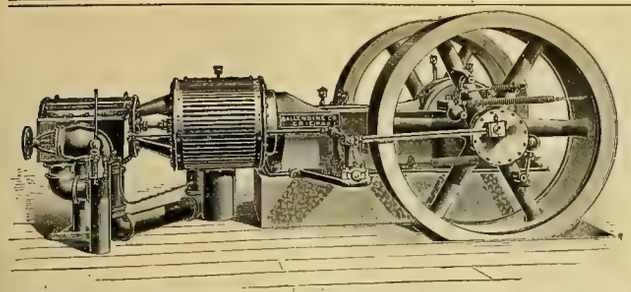

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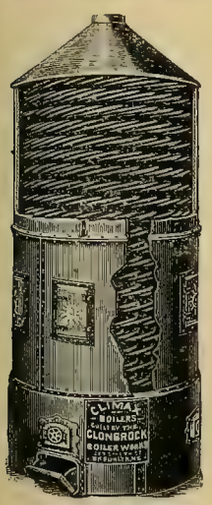

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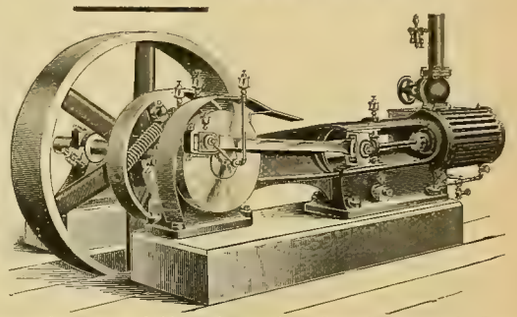

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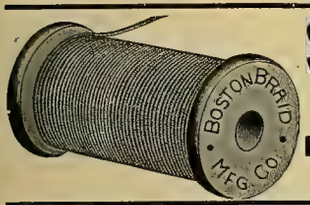

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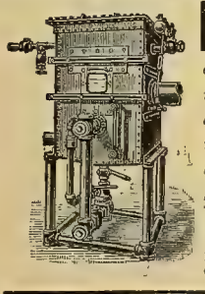

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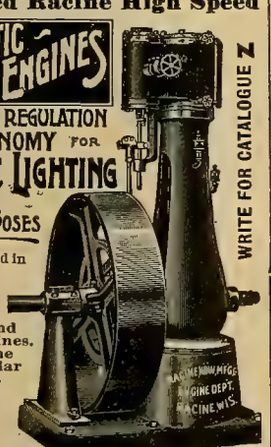

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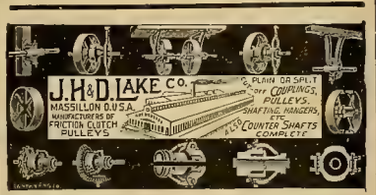

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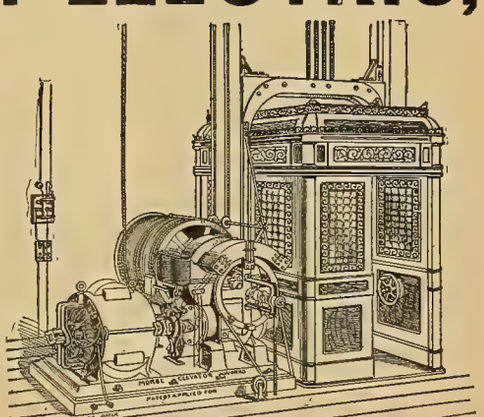

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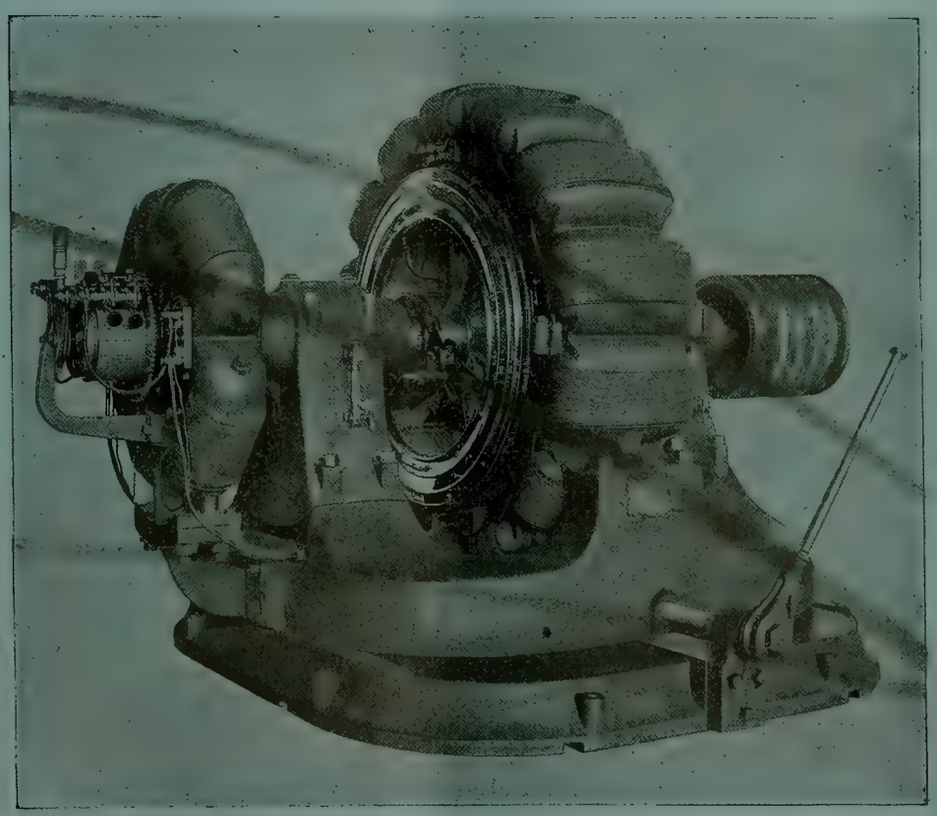

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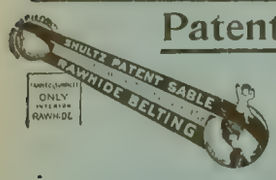

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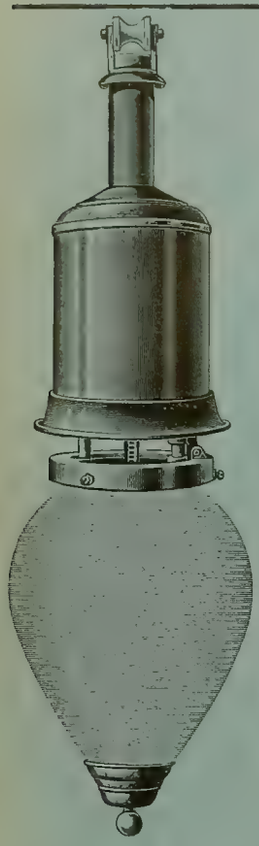

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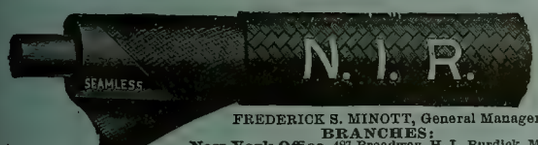

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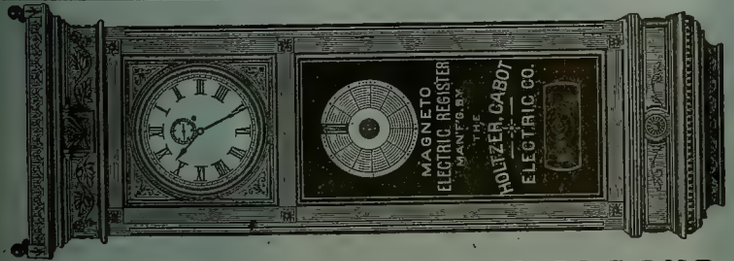

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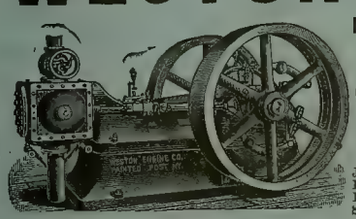

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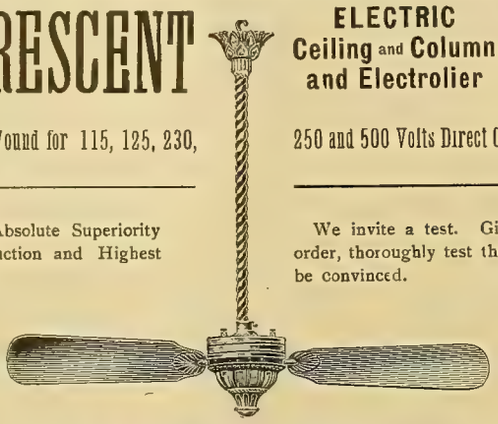

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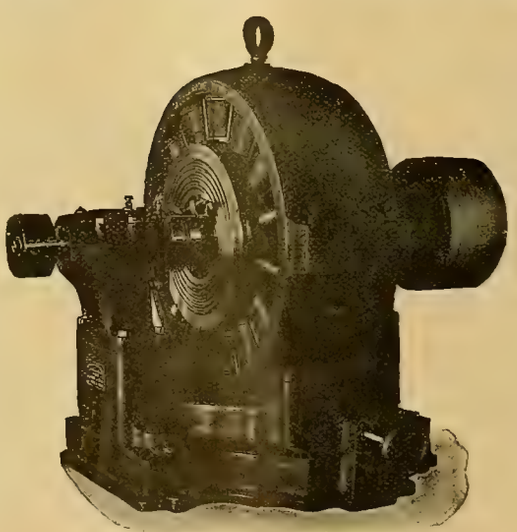

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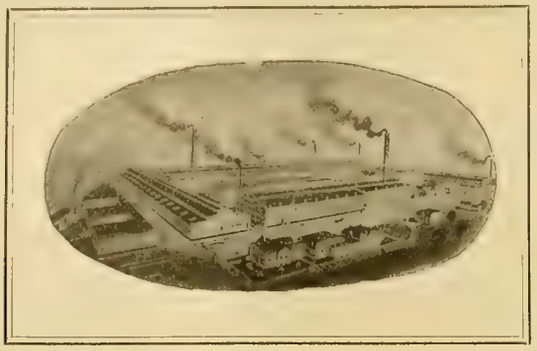

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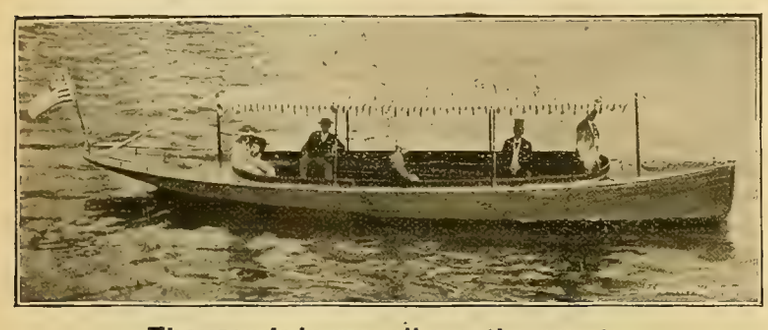

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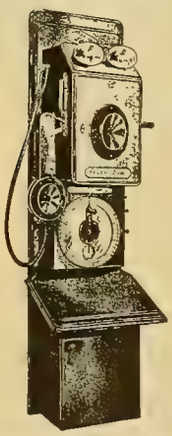

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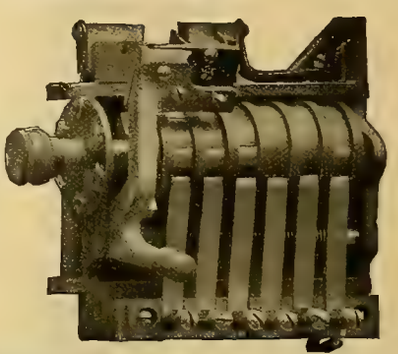

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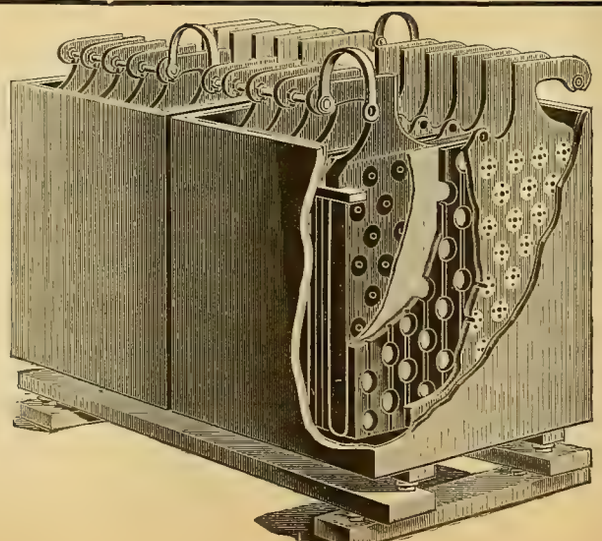

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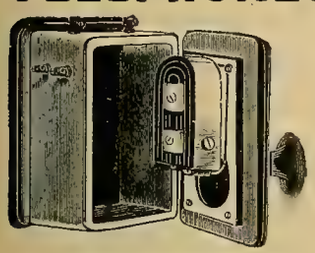

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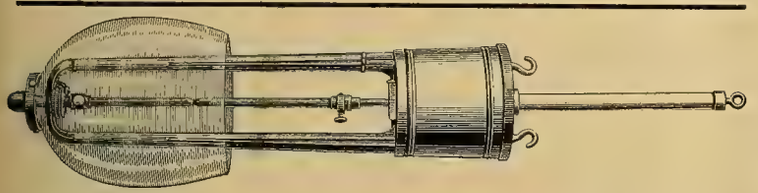

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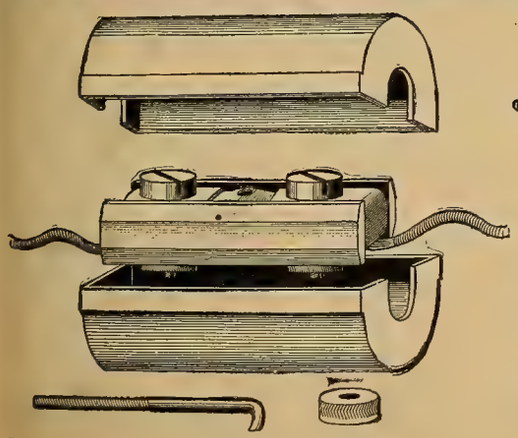
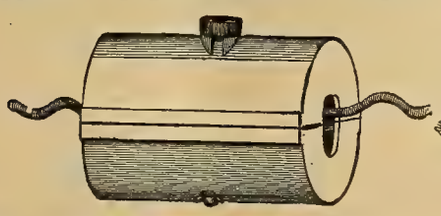


Enlarged cut showing construction of Gleason's Porcelain Lighting-Bug Cut-Out covered with porcelain.



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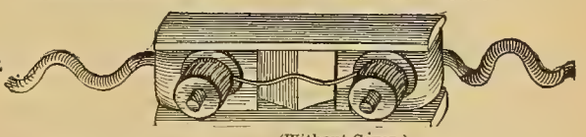

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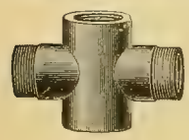

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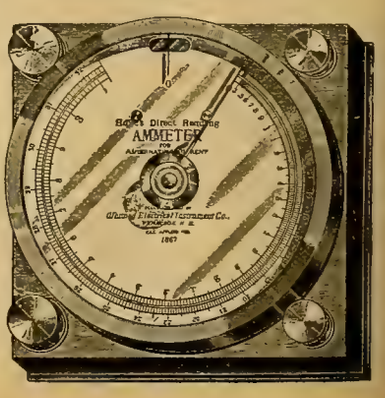

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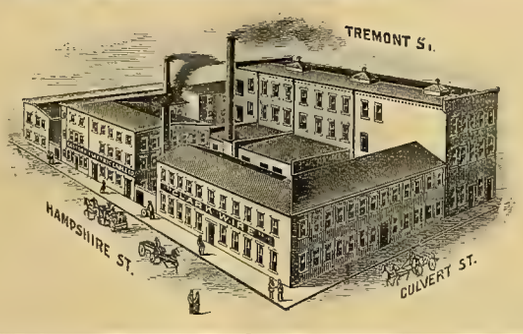

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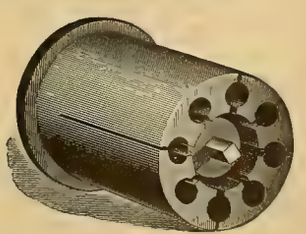

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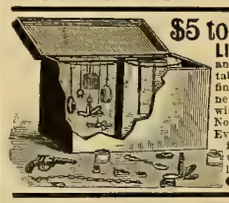

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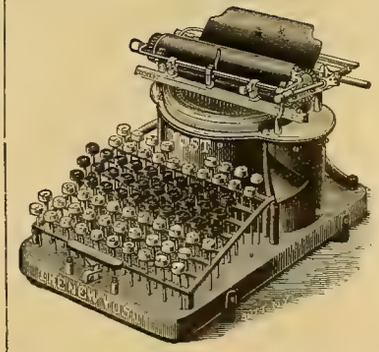

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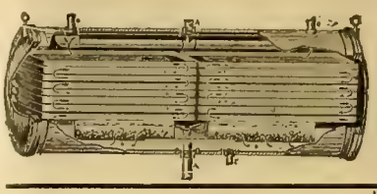

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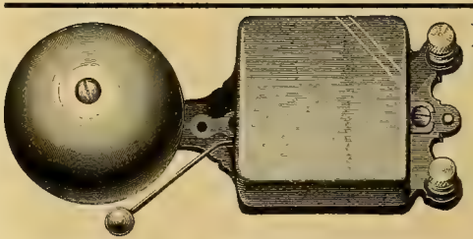

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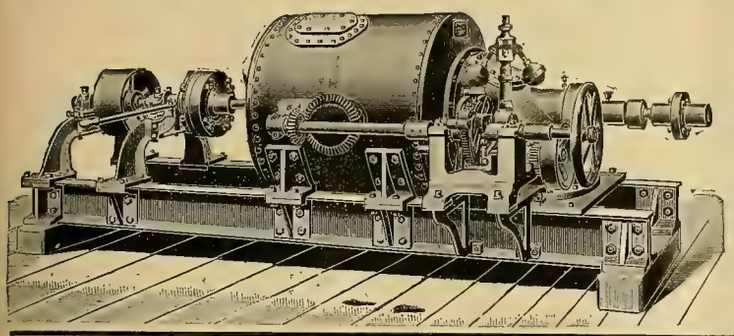

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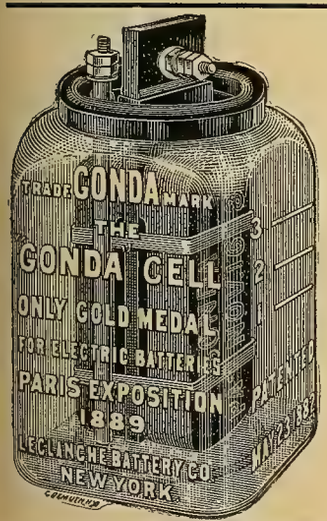

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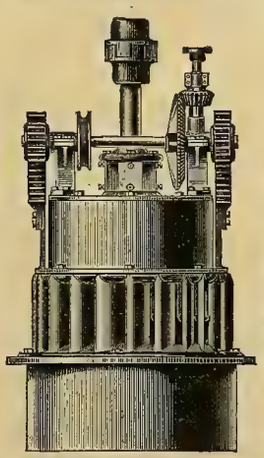

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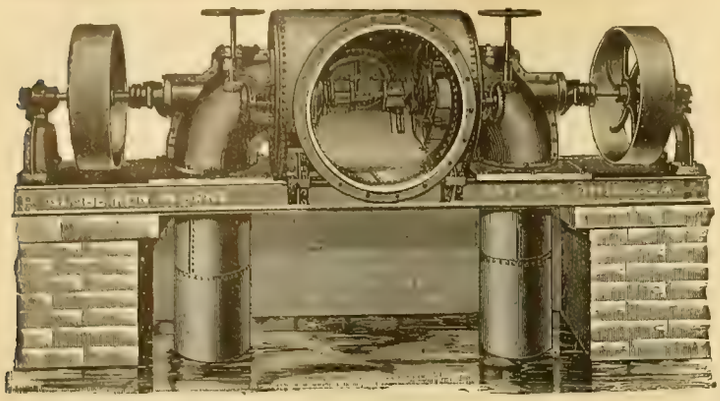

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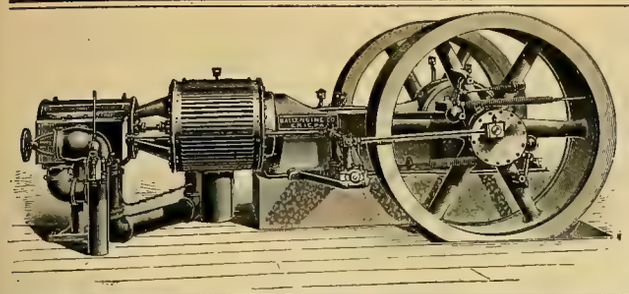

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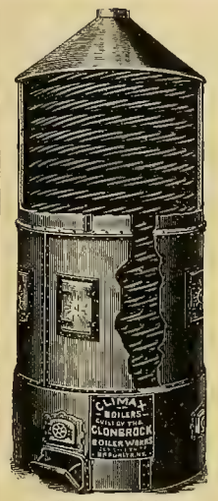

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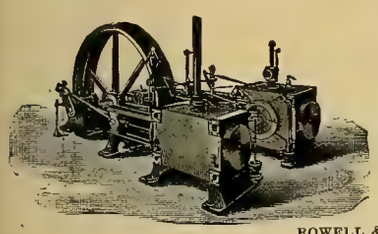

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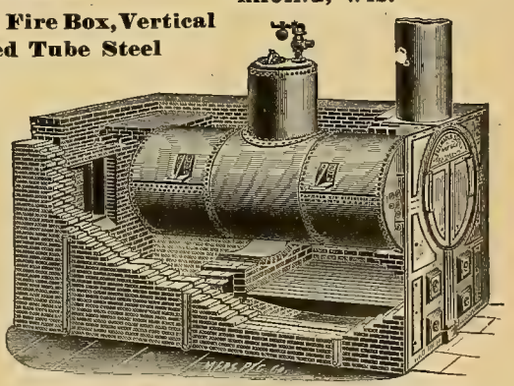

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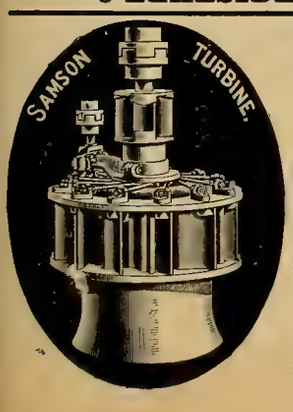

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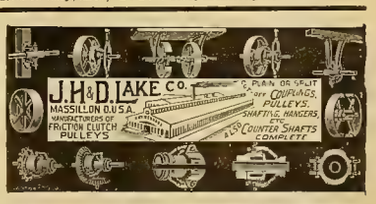

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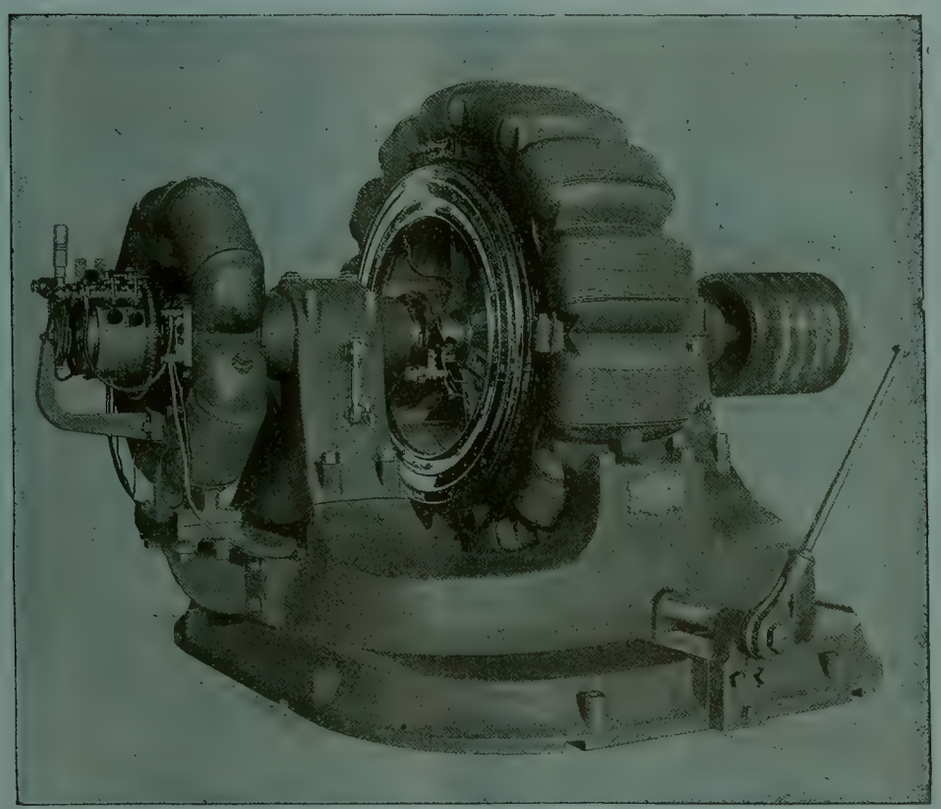

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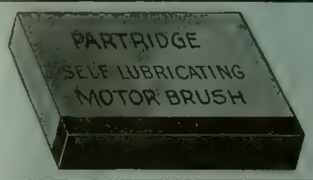

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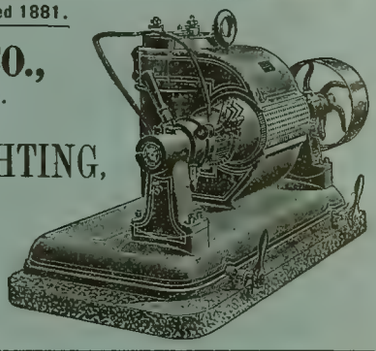

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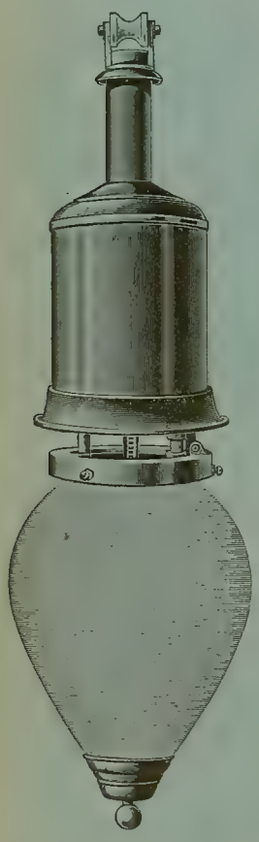

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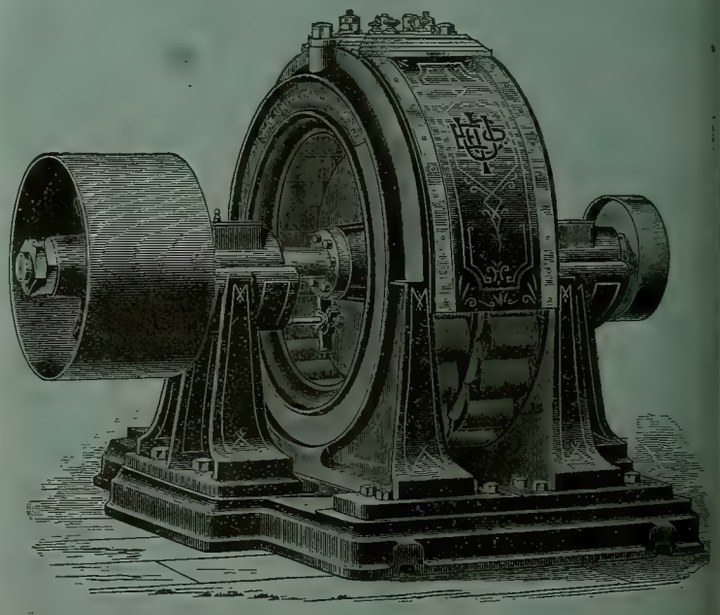

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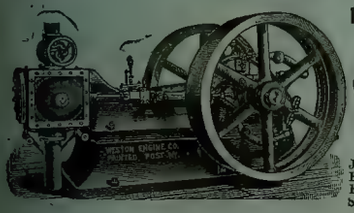

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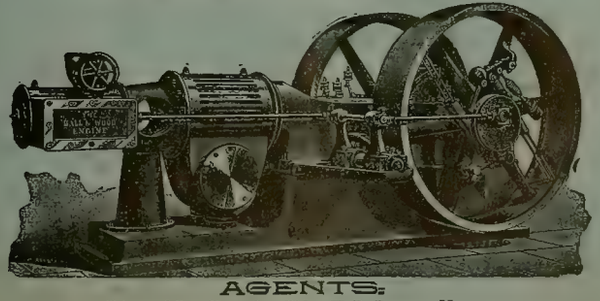

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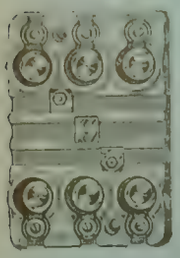

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Buffalo, N. Y., Erie County Savings Bank Building.
Philadelphia, Pa., 509 Arch St.
Pittsburgh, Pa., 425 Wood St.
Baltimore, Md., 18 South St.
St. Louis, Mo., Wainwright Building.
Portland, Ore., Front and Ankeny Sts.
St. Paul, Minn., 403 Sibley St.
Helena, Mont., Electric Building.
Washington, D. C., 1333 F St., N. W.
Atlanta, Ga., Equitable Building.
Cincinnati, O., 264 W. Fourth St.
Cleveland, O., 510 Cuyahoga Building.
Chicago, Ill., Monadnock Building.
Omaha, Neb., 309 South St.
Kansas City, Mo, New York Life Building.
Dallas, Tex. Cor. Field and Main Sts.
Denver, Colo., Masonic Temple.
San Francisco, Cal., 15 First St.
Seattle, Wash., Bailey Building.

For all BUSINESS OUTSIDE the UNITED STATES and CANADA: THOMSON-HOUSTON INTERNATIONAL ELECTRIC CO., SCHENECTADY, N. Y., and 44 BROAD ST., NEW YORK. FOR CANADA: CANADIAN GENERAL ELECTRIC CO., LTD., TORONTO, CAN.

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Cons. Electric St rage Co.
Electric Storage Battery Co

Adjusters, Lamp.
Dow Adjuster Co.

Annunciators.
Central Electric Co.
Electric Applisnce Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander &Co., W. R.
Western Elec. Supply Co.

Arc Lamps.
C & C Electric Co.
Clark Electric Co.
Electric Appliance Co.
Electric Cons. & Supply Co.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Royal Arc Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Standard Electric Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

Arc Light Cord.
Central Electric Co.
Electric Appliance Co.

Armature Winders.
Rushmore, S. W.
Stanwood M'f'g Co.

Batteries and Jars.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Central Electric Co.
Columbia Rubber Wks. Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Peru Electric Mfg. Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Bells.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E.S.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Western Electric Co.
Western Elec. Supply Co.

Belting,
Columbia Rubber Wks. Co.
Shultz Belting Co.

Bicycles
Ames & Frost Co.
Columbia Carriage & C. Co.

Boilers.
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Clonbrock Steam Boiler Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Link Belt Machinery Co.
Racine Hardware Co.
Stirling Co., The.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Brushes, Dynamo and Motor.
Partridge Carbon Co.
Wirt, Chas.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Cables(See Insulated Wires,)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Hill, W. S. Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

Carbons, Points & Plates.
Central Electric Co.
General Electric Co.
Law Battery Co.
Leclanche Battery Co.
Metropolitan Electric Co.
Partridge Carbon Co.
Western Electric Co.

Car-Heaters, Electric.
Consolidated Car-Heating Co.

Clutches, Friction.
Lake, J. H. & D. Co.
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Construction & Repairs.
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Arnold, B. J.
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Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
La Roche Electric Wks.
Mather Electric Co.
Monrath, Gustave.
Osburn, Harry G.
Roberts & Co., E. P.
Siemens & Halske Elec. Co.
Stone, O. M.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

Copper.
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Miamisburg Electric Co.

Copper Wires.
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Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Electric Co
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Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

Cross-Arms, Pins and Brackets.
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.

Cut-Outs and Switches.
Anderson, Albert & J. M.
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Bryant Electric Co.
Bunnell & Co., J. H.
C. & C. Electric Co.
Central Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Hammond Cleat & Ins. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Huebel & Manger.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Perkins Elec. Switch Mfg. Co.
Sioux City Brass Works.
Wallace Electric Co.
Western Elec. Supply Co.

Desk Lights.
Cooke, E. D.

Dynamos.
Brush Electric Co.
C. & C. Electric Co.
Clark Electric Co.
Colburn Electric Mfg.Co.
Elbridge Elec. Mfg. Co.
General Electric Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Rose Elec. Light Supply Co.
Siemens & Halske Elec. Co.
Standard Electric Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. &Mfg.Co.

Electric Railways.
Brush Electric Co.
General Electric Co.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
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Consolidated Eng. Co.
Goltz & Sinclair.
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Osburn, Harry G.
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Stone, O. M.
Wirt, Chas.

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Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.
Wirt, Chas.

Electrical Specialties.
Cooke, E. D.
Electric Appliance Co.
General Electric Co.
Holtzer-Cabot Electric Co.

Electric Slate.
Independent Electric Co.

Electroliers, etc.
Baggot, E.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

Electro-Plating Mach'y.
Colburn Electric Mfg. Co.
General Electric Co.

Engines, Steam.
Ball & Wood Co., The.
Ball Engine Co.
Brownell & Co., The.
Freeman Sons Mfg. Co.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Weston Engine Co.

Elevators, Electric.
Morse, Williams & Co.

Fan Outfits.
Bolgiano Mfg. Co.
Diehl & Co.
Central Electric Co.
Chi. Water Motor & Fan Co.
Crescent Electric Co.

Fibre
American Hard Fibre Co.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

Fire Alarms.
Butler Hard Rubber Co.
Columbia Rubber Wks. Co.
Western Electric Co.

Fuse Wire.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

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American Electric Co.
Holtzer-Cabot Electric Co.

Gears.
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Lasell & Co., Edw.
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Peru Electric Mfg. Co.
Rafferty & Co., T. C.
Rushmore, S. W.
Sioux City Brass Works.
Wallace Electric Co.
Western Elec. Supply Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason E. P. Mfg. Co.
Hemingray Glass Co.
Phœnix Glass Co.

Graphite Specialties.
Dixon Crucible Co., Jos.

Hard Rubber Goods.
American Hard Fibre Co.
Butler Hard Rubber Co.
Columbia Rubber Wks. Co.
Delaware Hard Fibre Co.

Insulators and Insulating Materials.
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Bernard Co., The E. G.
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Columbia Rubber Wks. Co.
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Standard Paint Co.
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Cushing & Morse.
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Western Elec. Supply Co.

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Cooke, E. D.

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Beacon Vac Pump & Elec.Co.
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Buckeye Electric Co.
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Electric Appliance Co.
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Lasell & Co., Edw.
Mather Electric Co.
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New York & Ohio Co.
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Royal Arc Electric Co.
Westinghouse Elec.&Mfg.Co.

Lightning Arresters.
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Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Wirt, Chas.

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Mechanical Machinery.
Bliss Co., E. W.
Link Belt Machinery Co.

Mica.
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Munsell & Co., Eugene.

Mining Apparatus, Elec.
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Independent Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Bolgiano Mfg. Co.
Brush Electric Co.
C & C Electric Co.
Chi. Water Motor & Fan Co.
Colburn Electric Mfg. Co.
Elbridge Elec. Mfg. Co.
General Electric Co
Gregory, Chas. E. Co
La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

Paints,
Standard Paint Co.

Phosphor Bronze.
Phosphor Bronze Sm.Co. Ltd.

Platinum.
Baker & Co.

Poles.
Brownlee & Co.
Morris, Tasker & Co.

Porcelain.
Empire China Works.
General Electric Co.
Peru Electric Mfg. Co.
Phœnix Glass Co.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electric Appliance Co
Huebel & Manger.
Metropolitan Electric Co.

Rheostats.
General Electric Co.

Sal Ammoniac.
Innis & Co.
Klipstein, A. & Co.
Law Battery Co.
Hayden-Booker Mfg. Co.

Second-Hand Electrical Machinery.
Gregory, Chas. E. Co.
Rose Elec. Lt. Supply Co.

Silk Braid.
Boston Braid Mfg. Co.

Slate.
Independent Electric Co.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Whitney Elec. Instrument Co

Steam Heating.
Webster & Co., Warren.

Steam Pumps.
Worthington, Henry R.

Storage Batteries.
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric Storage Battery Co.

Stoves, Electric.
Consolidated Car-Heating Co

Street Cars.
Brill, J. G. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Chicago Ins. Wire Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Paint Co.

Telegraph Apparatus.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

Telephones.
Columbia Rubber Wks. Co.
D'Unger Long Dist. Tel. Co.
Harrison Int. Telephone Co.
Lasell & Co., Edw.
Palmer Bros.
Western Electric Co.
Western Tel. Const. Co.

Transformers.
General Electric Co.
Hornberger Elec. Mfg. Co.
Stanley Electric Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stilwell & Bierce Mfg. Co.

Type-Writing Machines.
Yost Writing Machine Co.

Universities
Cor. School of Mechanics.
Correspondence School of Technology.
Rose Polytechnic Institute
Scientific Machinist Co.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels.
Leffel & Co., Jas.
Smith, S. Morgan.

Wire, Bare.
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.

ANNOUNCEMENT.

CHICAGO. THE SIMPLEX ELECTRICAL Co. BOSTON.

We beg to announce that the relations heretofore existing, by which Mr. George Cutter has been acting as our Western Selling Agent, have been dissolved.

Our Chicago Office will hereafter be located at 1137 and 1138 Monadnock Block, and Mr. H. R. Hixson, who has for some time been identified with our interests in Chicago, will be in charge. A stock of Simplex Wire will be kept on hand, from which prompt shipments can be made.

We desire to express our appreciation of the favor with which the trade has received our goods, and hope for a continuance of these pleasant relations under the new arrangement.

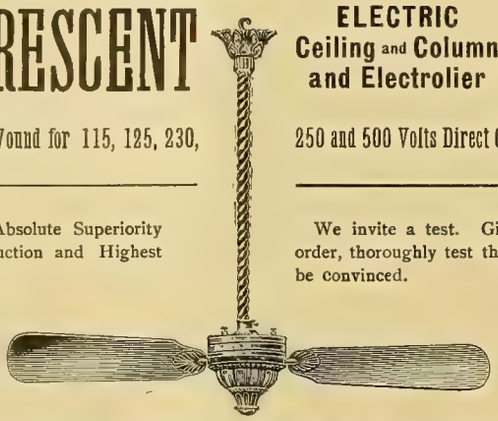
Tel. Harrison 305. Western Selling Agent, **H. R. HIXSON, 1137 and 1138 Monadnock, CHICAGO.**

THE CRESCENT ELECTRIC Ceiling and Column and Electrolier FANS

Are Wound for 115, 125, 230, 250 and 500 Volts Direct Current.

We claim Absolute Superiority of Construction and Highest Efficiency.

We invite a test. Give us a sample order, thoroughly test the Crescent, and be convinced.



THE CRESCENT ELECTRIC CO.,

Manufacturers of Electrical Specialties,

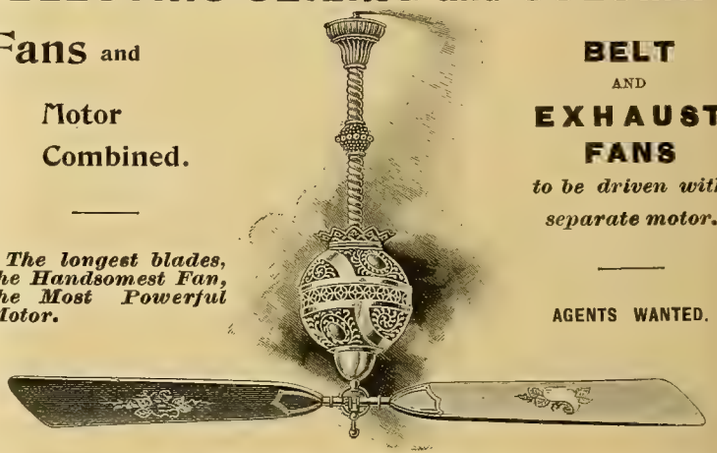
AGENTS WANTED. Lancaster, Pa.

ELECTRIC CEILING and COLUMN Fans and Motor Combined.

The longest blades, the Handsomest Fan, the Most Powerful Motor.

BELT AND EXHAUST FANS *to be driven with separate motor.*

AGENTS WANTED.



STYLE B. GLOBE PATTERN.

CHICAGO WATER MOTOR & FAN CO., 101 Lake St., CHICAGO.

THE DIEHL ELECTRIC FANS.

NO BELTS. NO SHAFTING.

CEILING, FLOOR COLUMN, COUNTER COLUMN FANS FOR DIRECT CURRENT.

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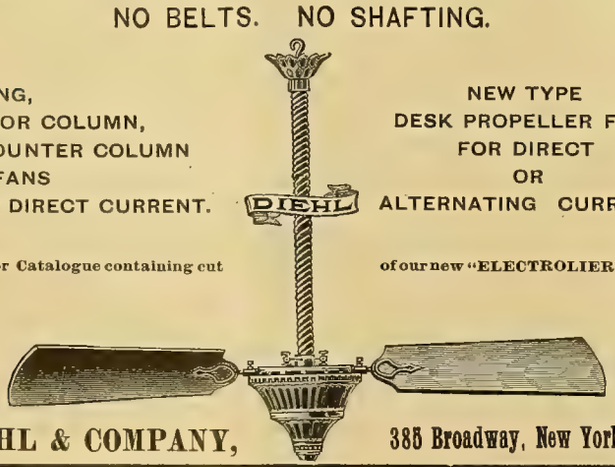

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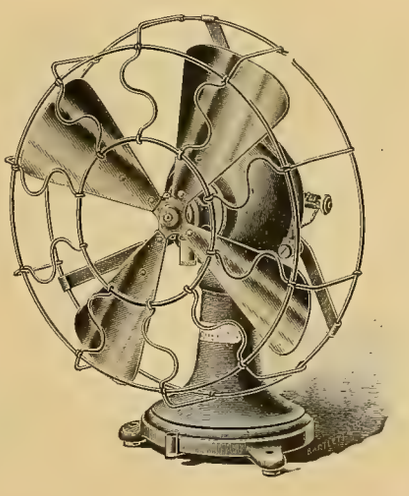

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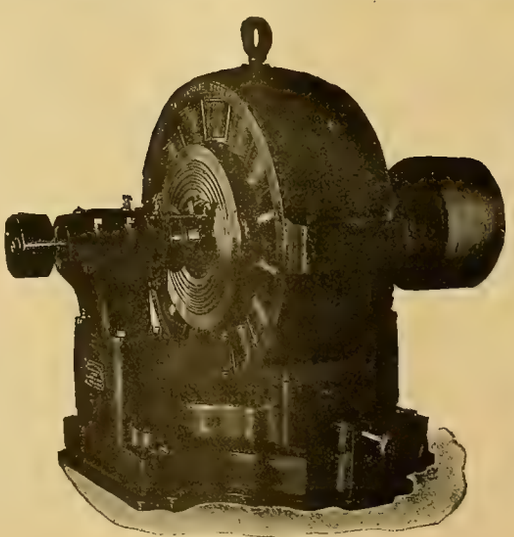

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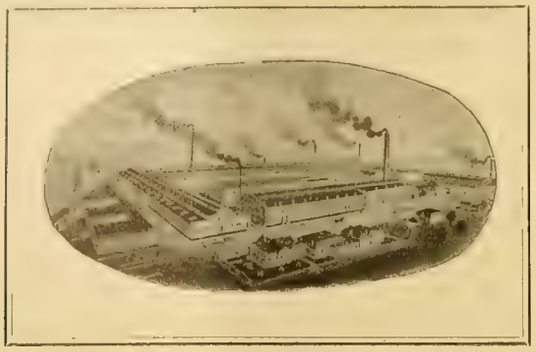

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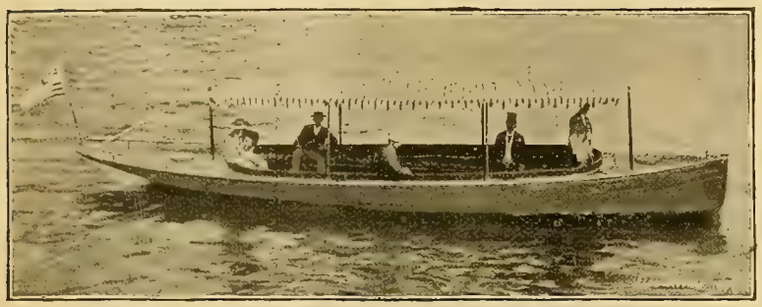

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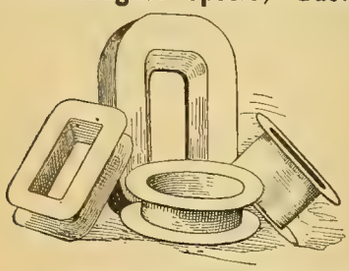

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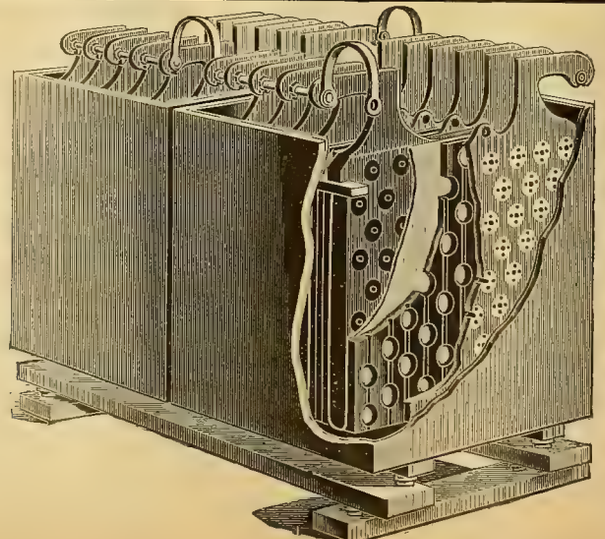

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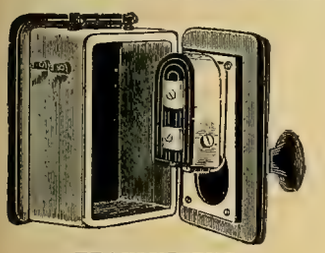

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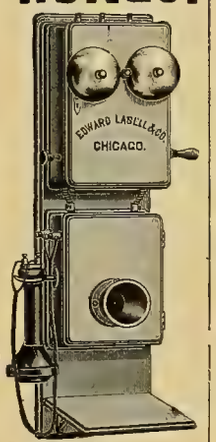

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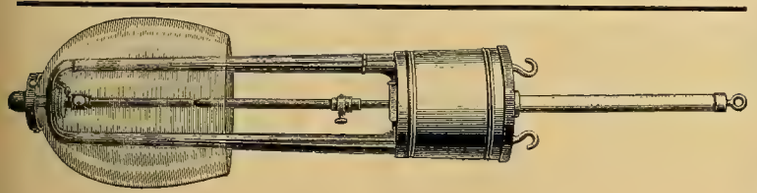

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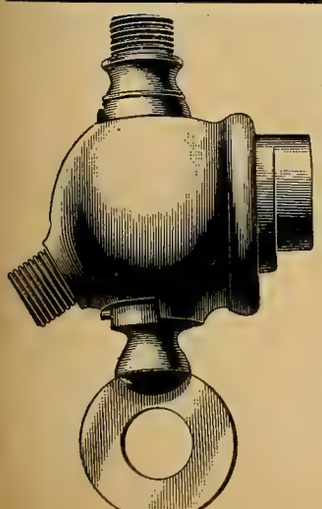

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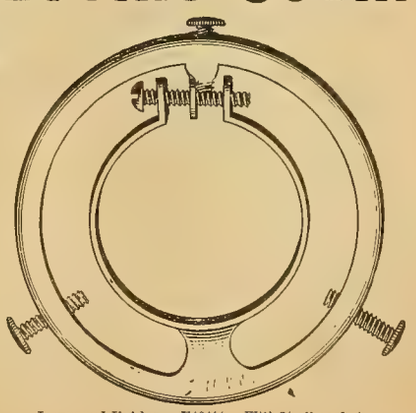

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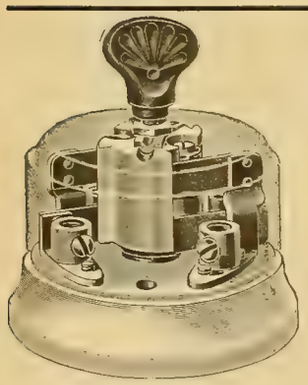

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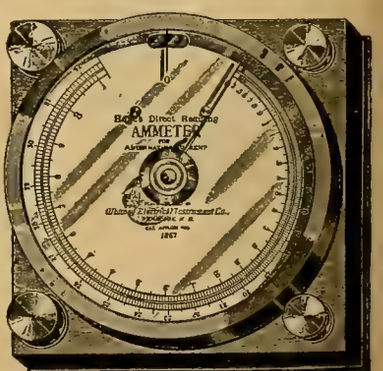

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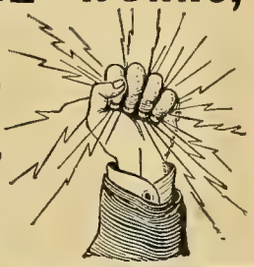

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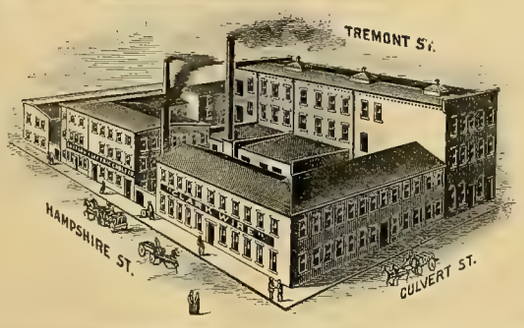

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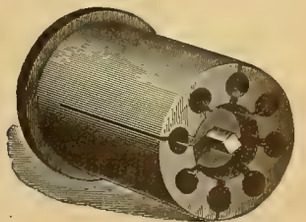

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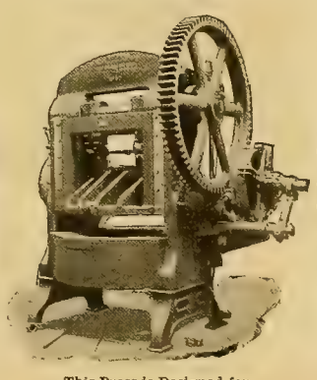

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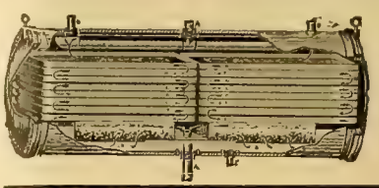

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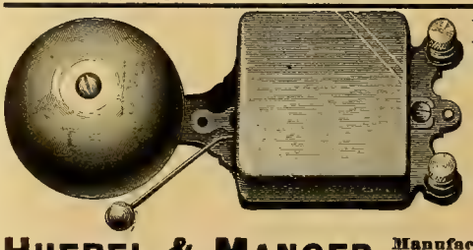

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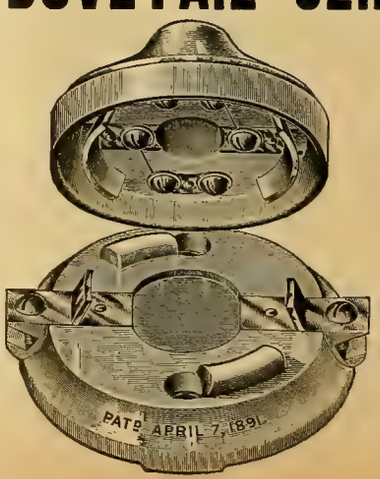

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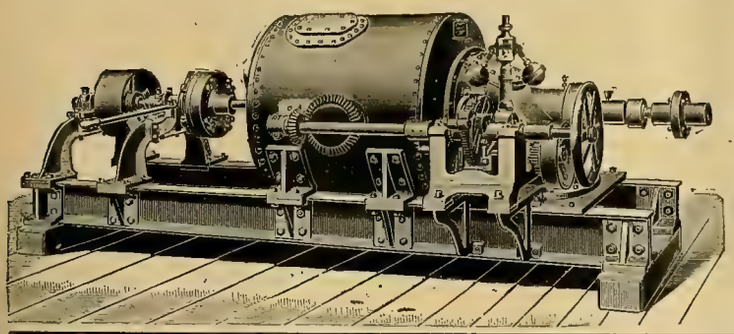
VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high speed and great Efficiency**, and **Large Capacity** for its **diameter**, being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect **guaranteed.** **SEND FOR CATALOGUE AND PARTICULARS.**

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Is the best Cell in this or any other Country.

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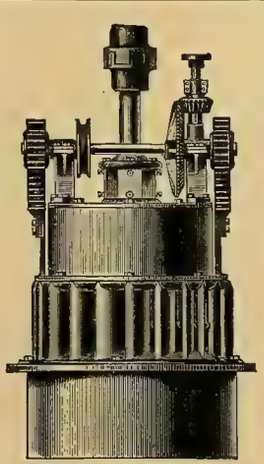

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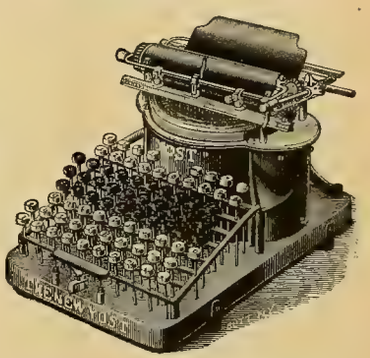

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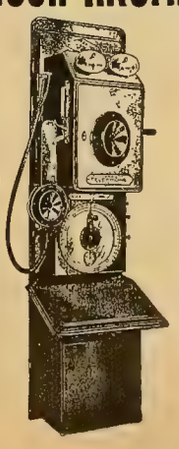

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We either sell our telephones outright or lease them for a term of years.

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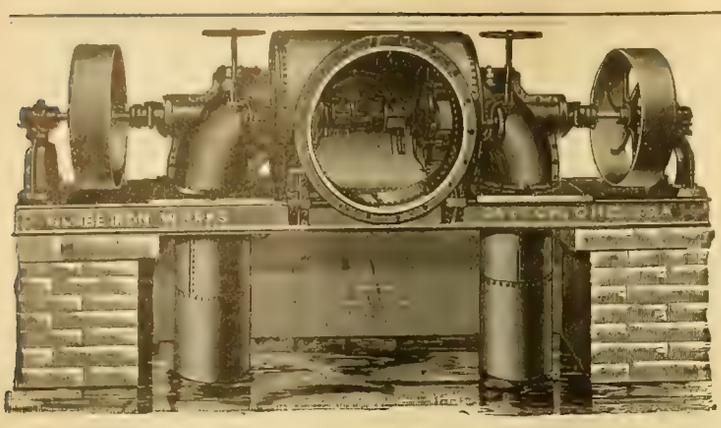

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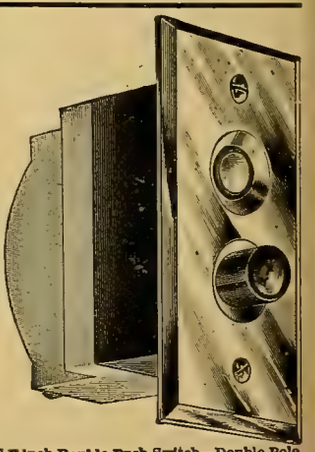

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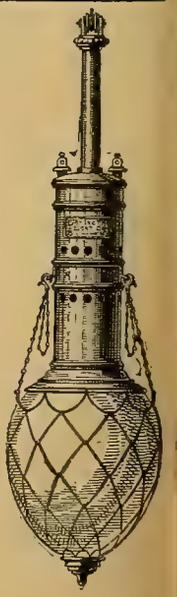

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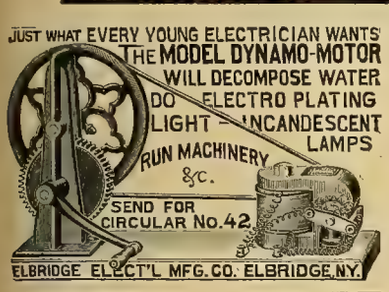

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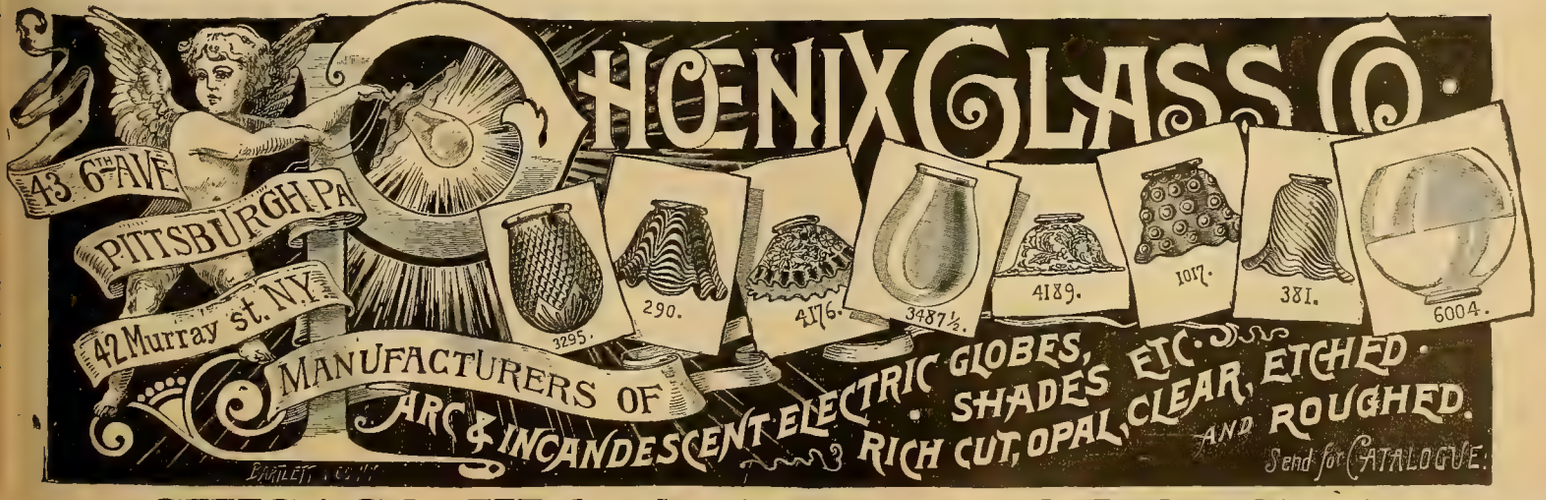

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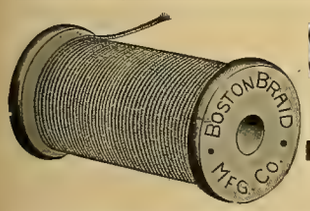

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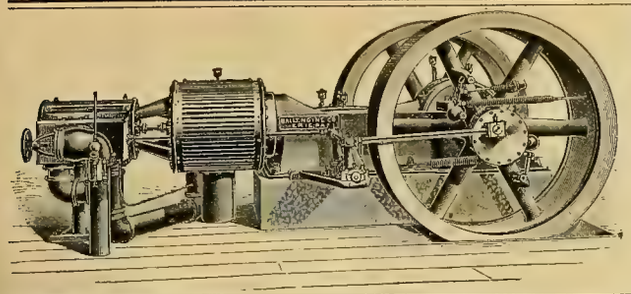

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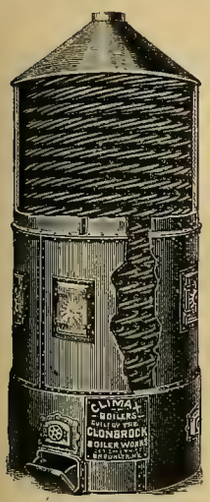

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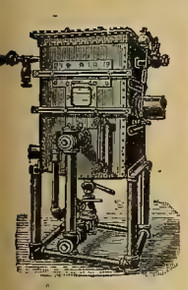

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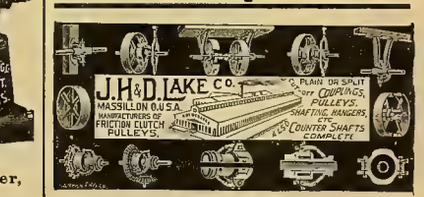

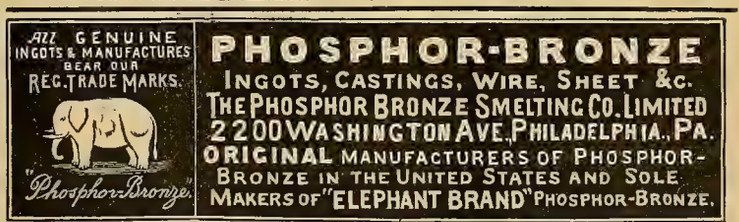

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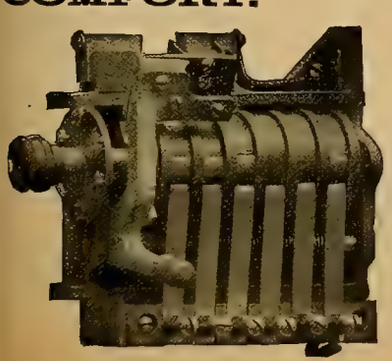

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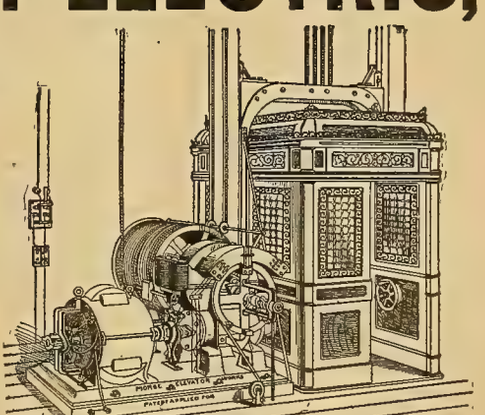

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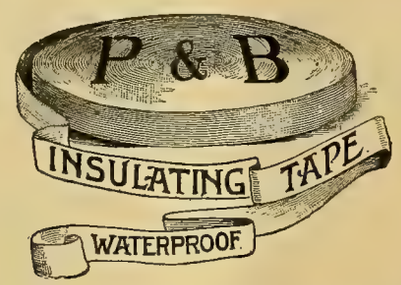

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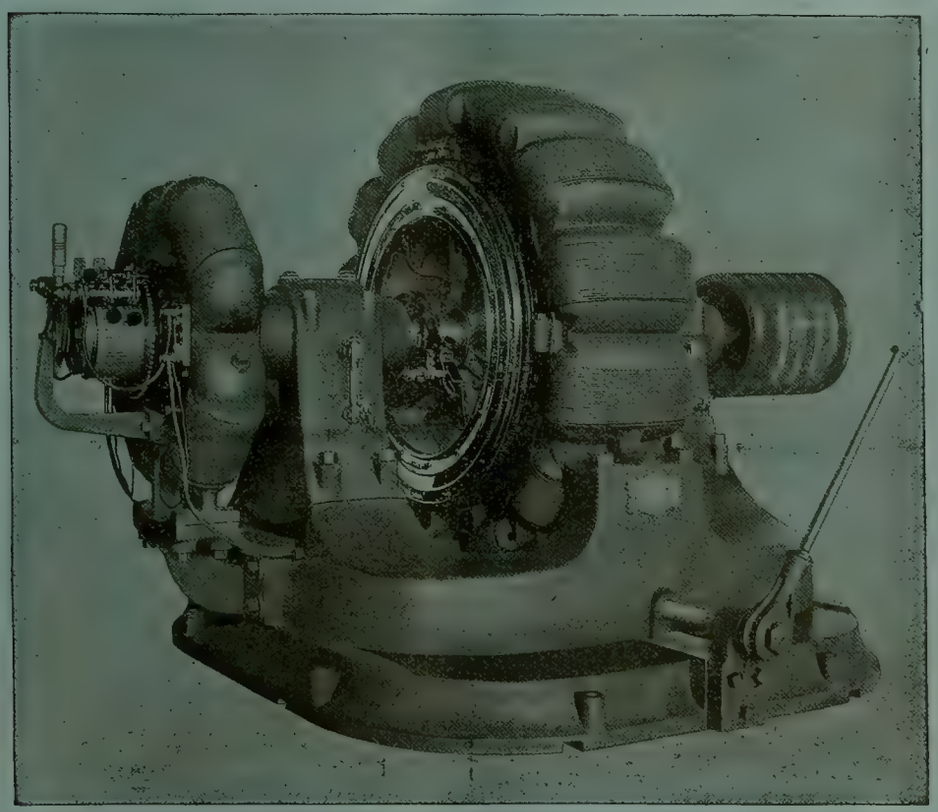

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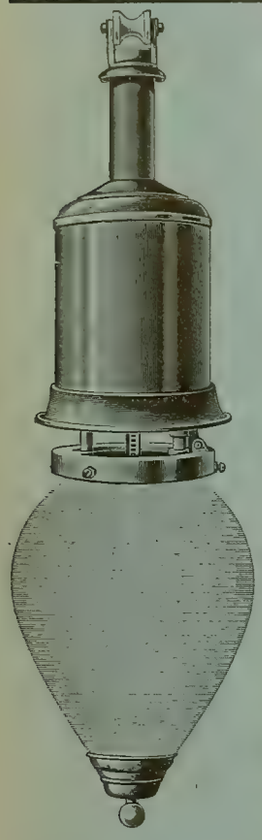

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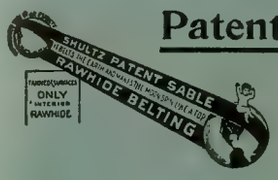

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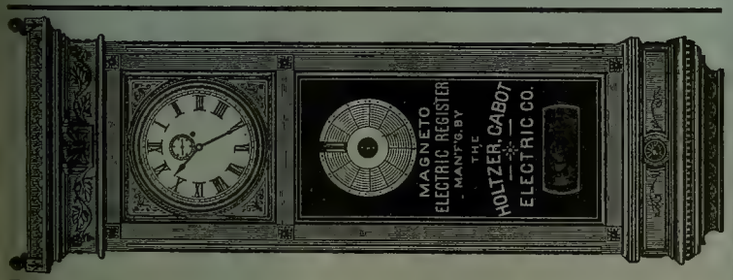

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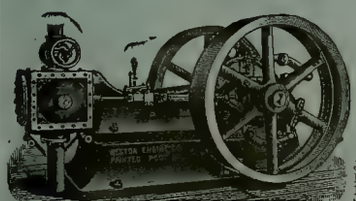

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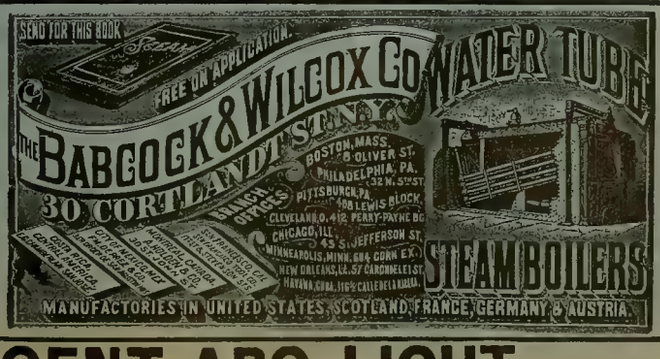

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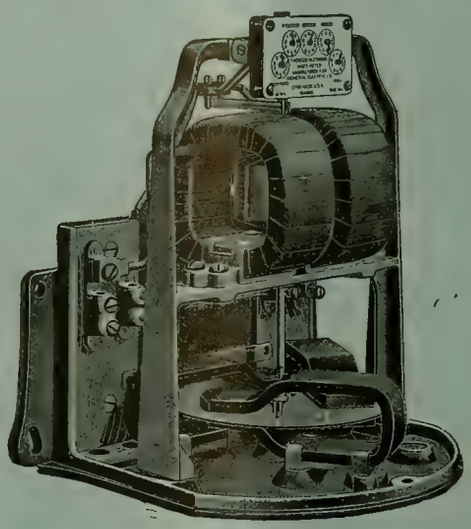

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Leffel & Co., Jas.
Smith, S. Morgan.

Wire, Bare.
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ANNOUNCEMENT.

CHICAGO, THE SIMPLEX ELECTRICAL Co. BOSTON,

1137-1138 Monadnock. 75-81 Cornhill Street.

We beg to announce that the relations heretofore existing, by which Mr. George Cutter has been acting as our Western Selling Agent, have been dissolved.

Our Chicago Office will hereafter be located at 1137 and 1138 Monadnock Block, and Mr. H. R. Hixson, who has for some time been identified with our interests in Chicago, will be in charge. A stock of Simplex Wire will be kept on hand, from which prompt shipments can be made.

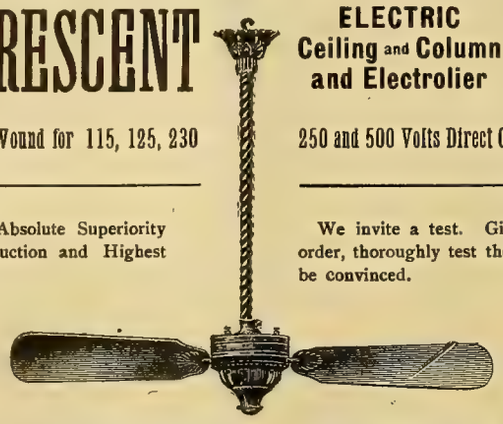
We desire to express our appreciation of the favor with which the trade has received our goods, and hope for a continuance of these pleasant relations under the new arrangement.

THE SIMPLEX ELECTRICAL CO.

Western Selling Agent, H. R. HIXSON, 1137 and 1138 Monadnock, CHICAGO. **Tel. Harrison 305.**

THE CRESCENT ELECTRIC Ceiling and Column and Electrolier FANS

Are Wound for 115, 125, 230 — 250 and 500 Volts Direct Current.



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We invite a test. Give us a sample order, thoroughly test the Crescent, and be convinced.

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Manufacturers of Electrical Specialties,

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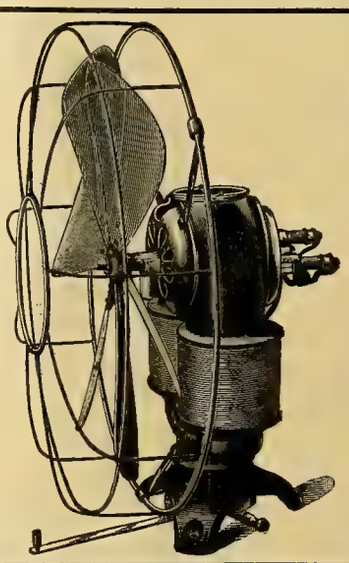

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FANS
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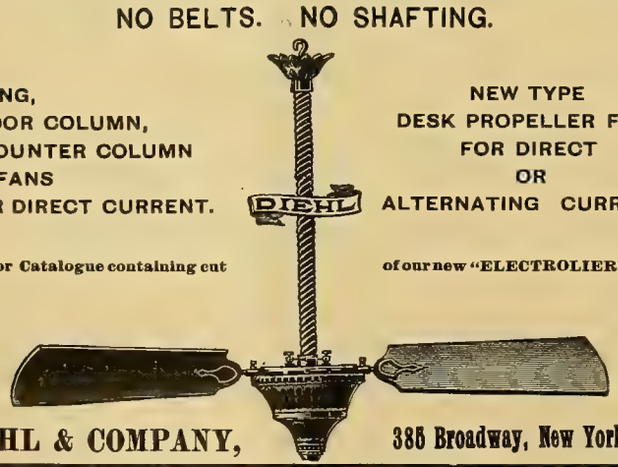

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WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE

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We either sell our telephones outright or lease them for a term of years.

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

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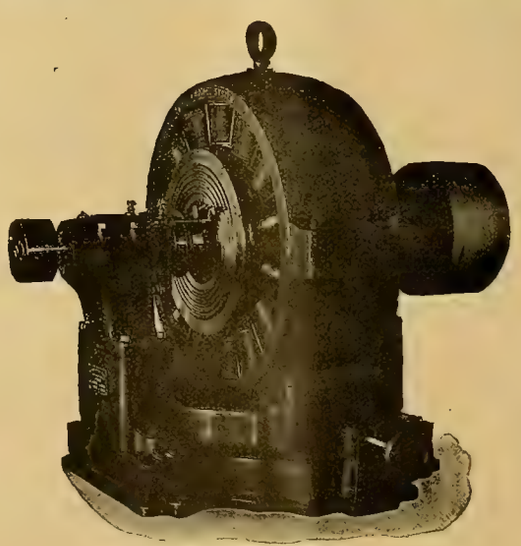

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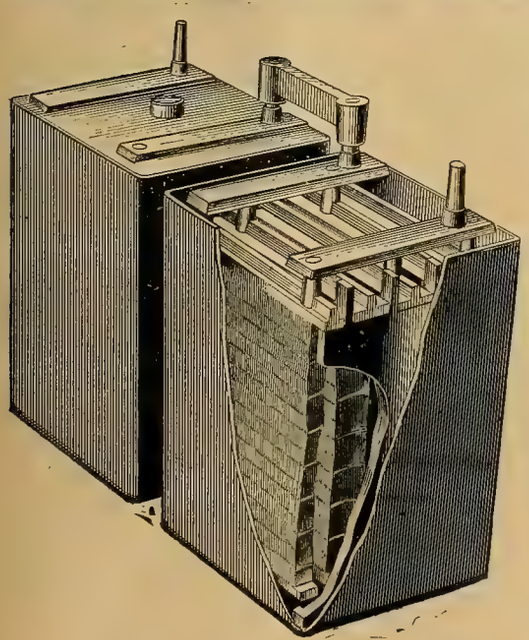

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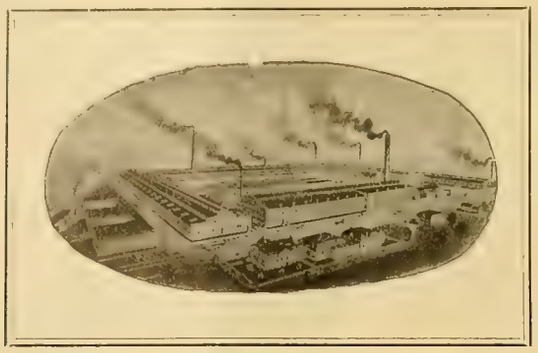

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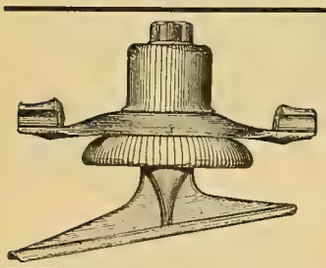

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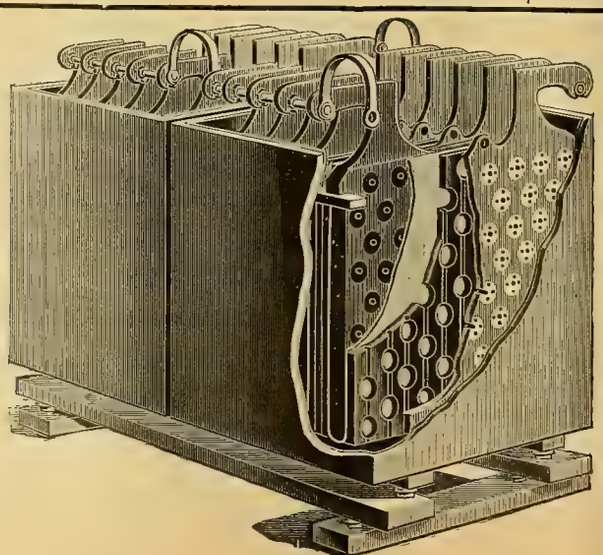

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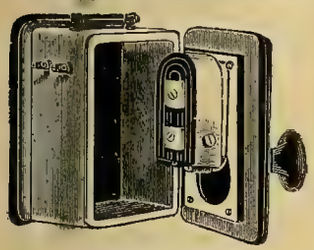

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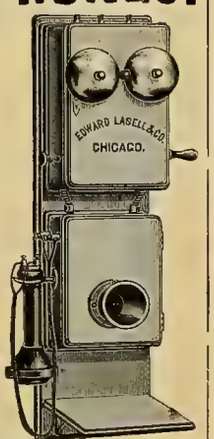

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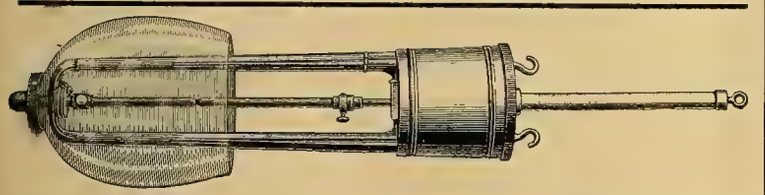

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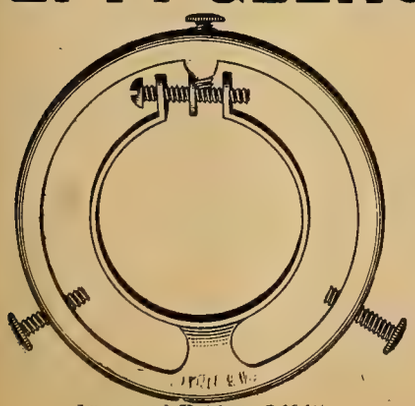

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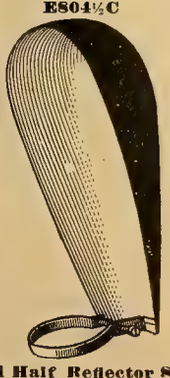

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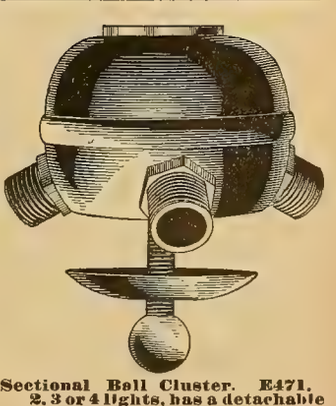

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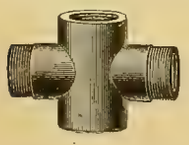

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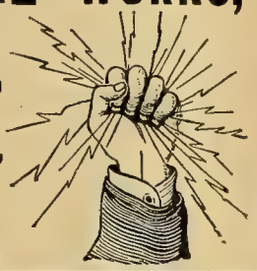

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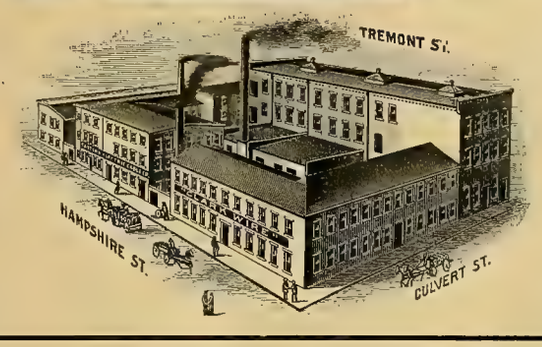

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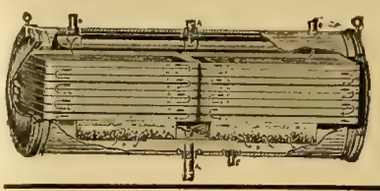

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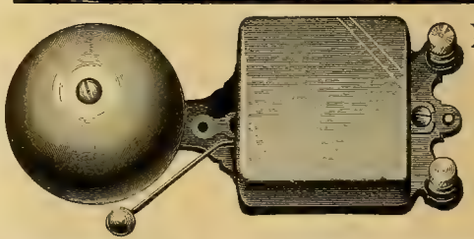

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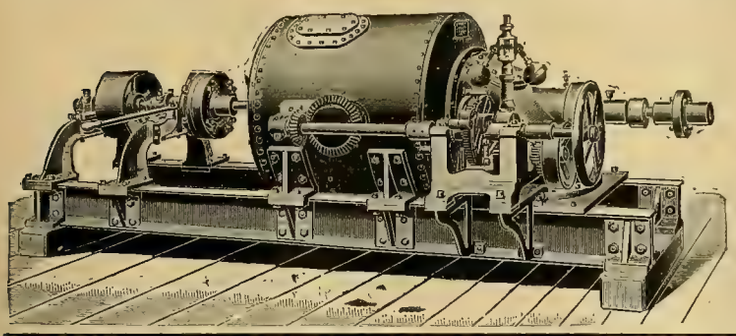

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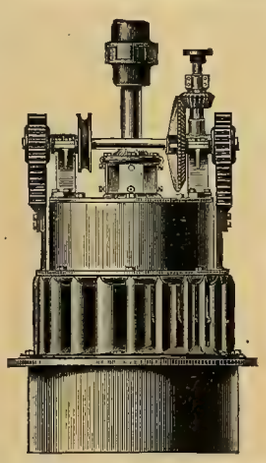

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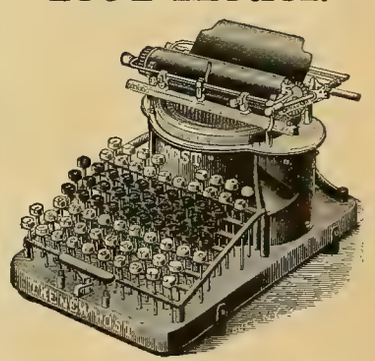

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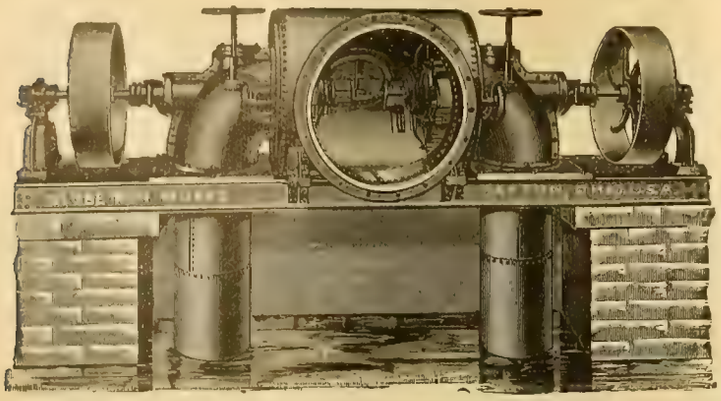

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CHAPTER 10....Motor with "Current Lag" Artificially Secured.
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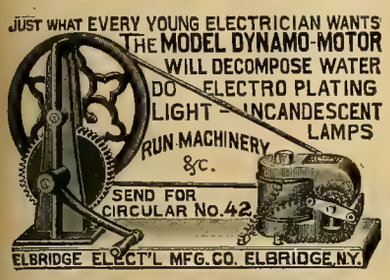

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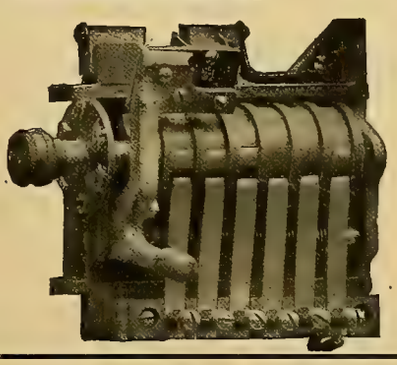

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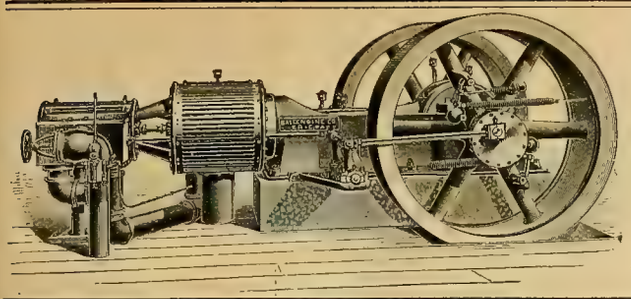

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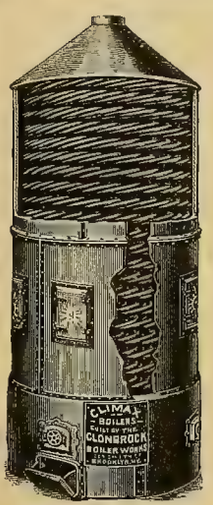

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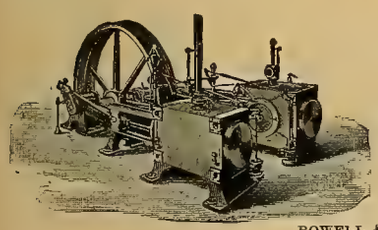

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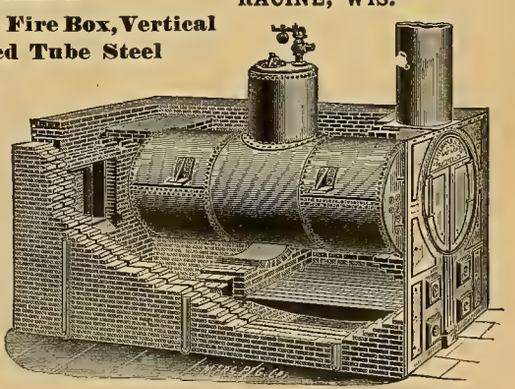

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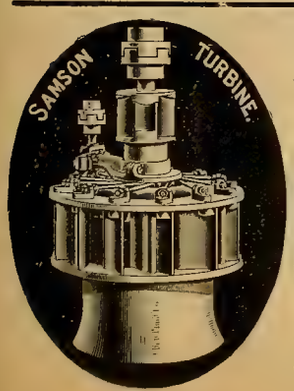

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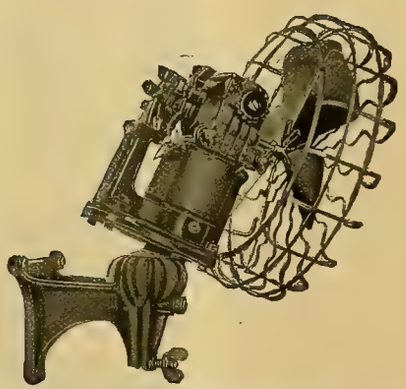

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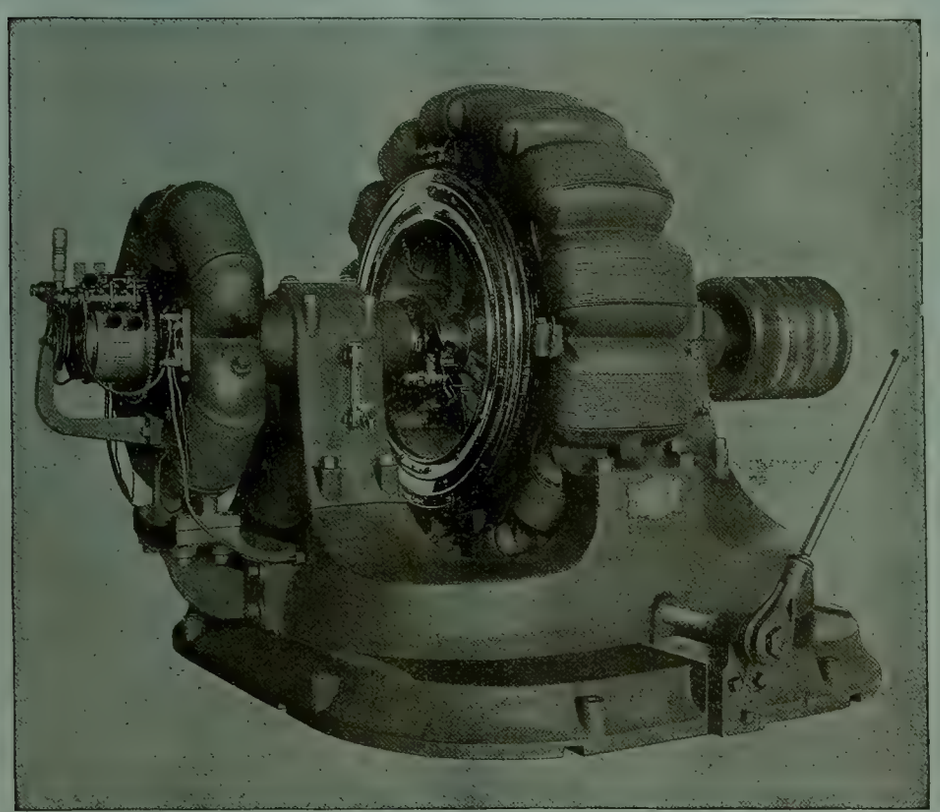

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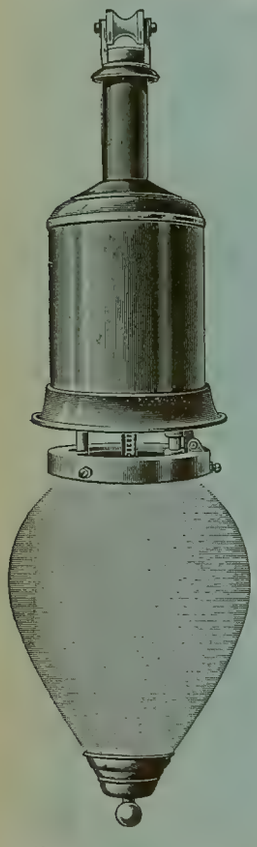

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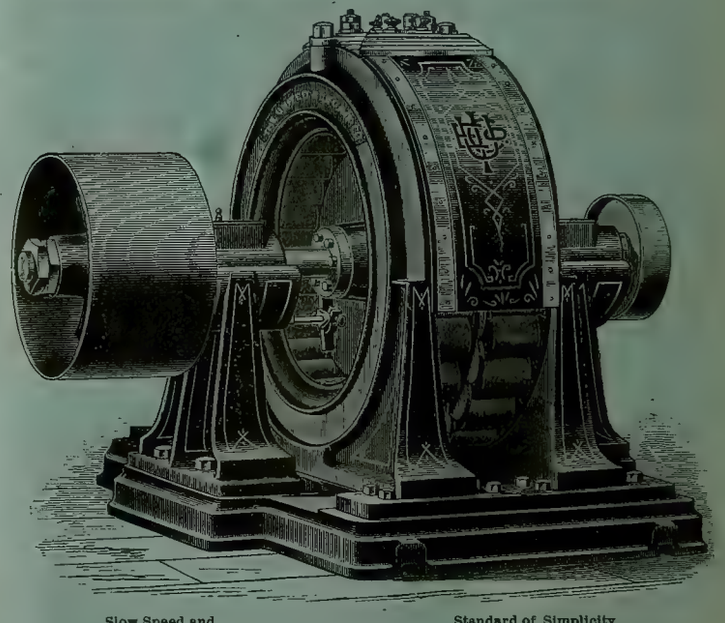

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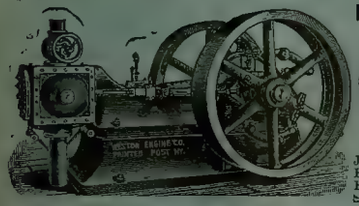

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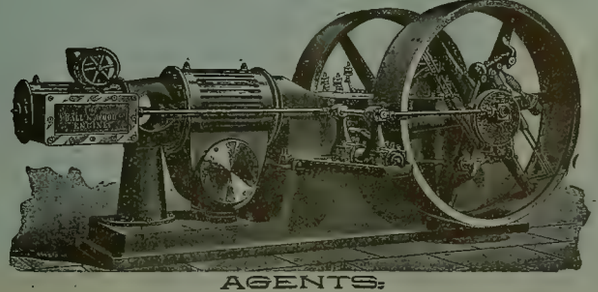

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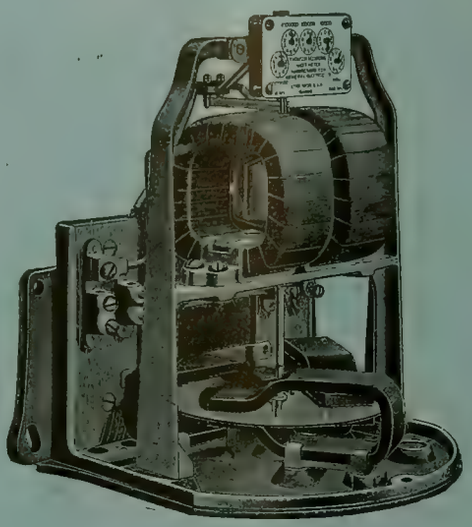

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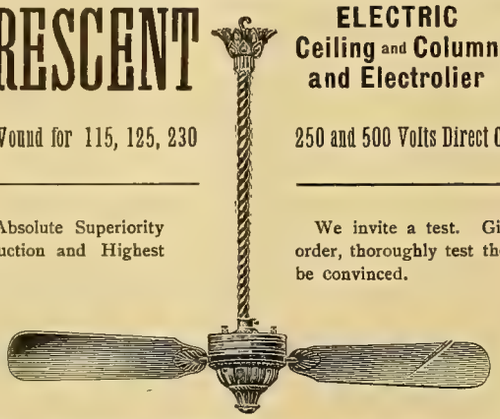

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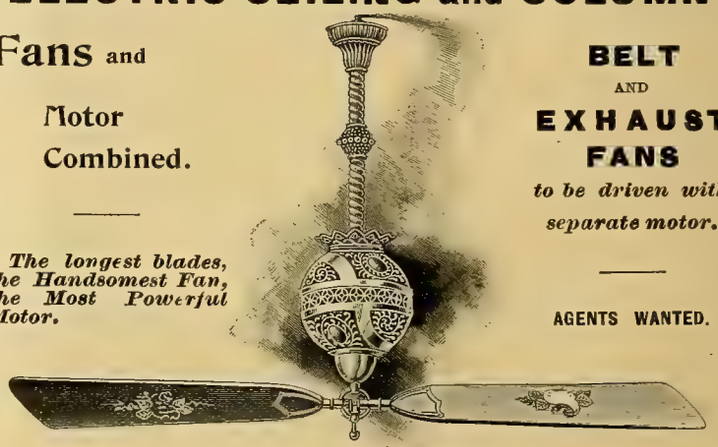

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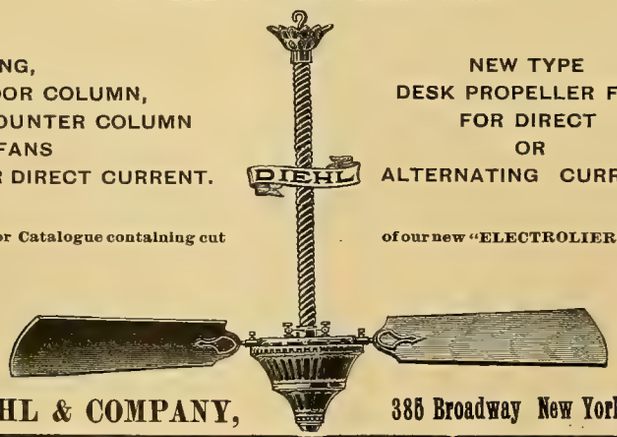

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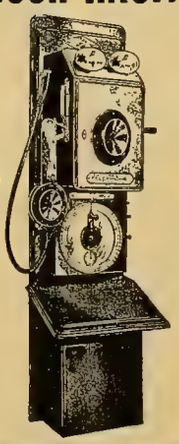

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We either sell our telephones outright or lease them for a term of years.

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

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TWO PHASE GENERATORS

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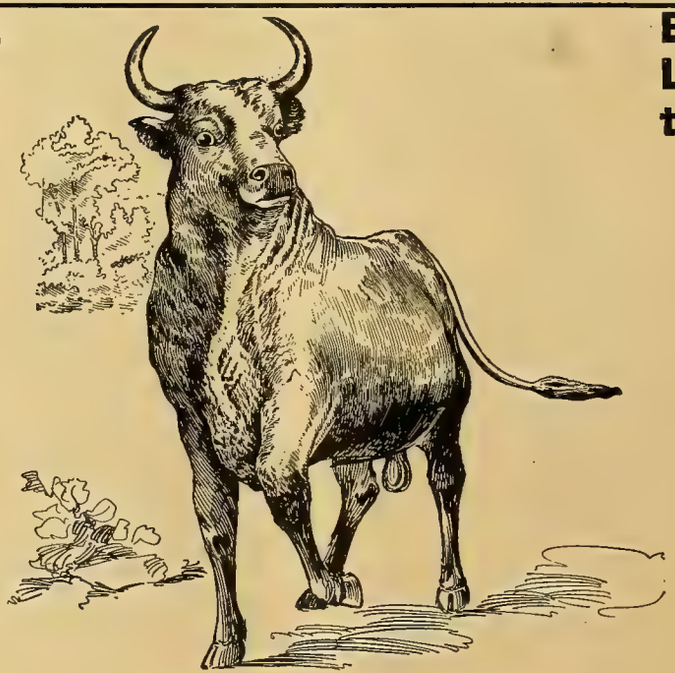
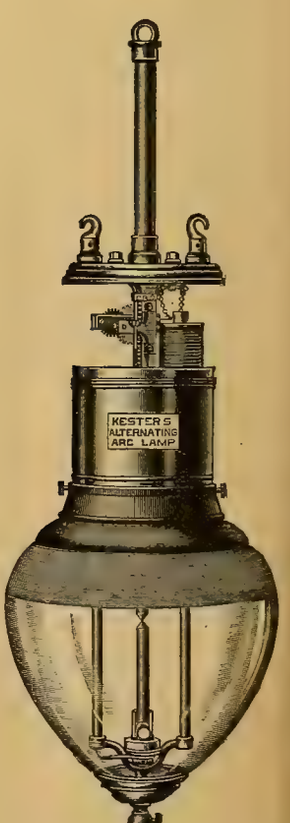


By Buying any Lamp before the



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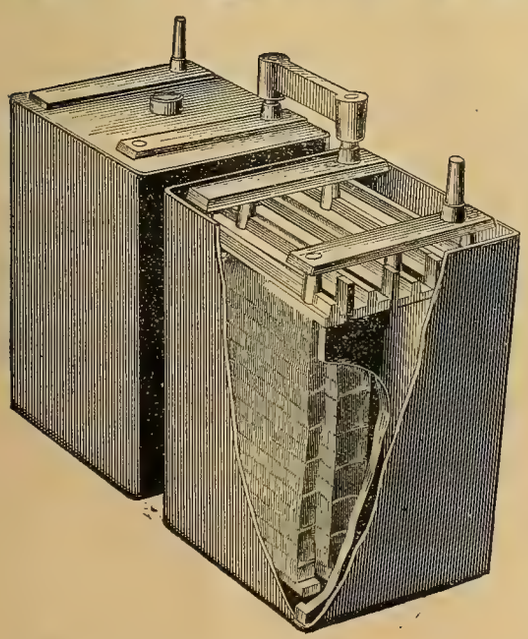

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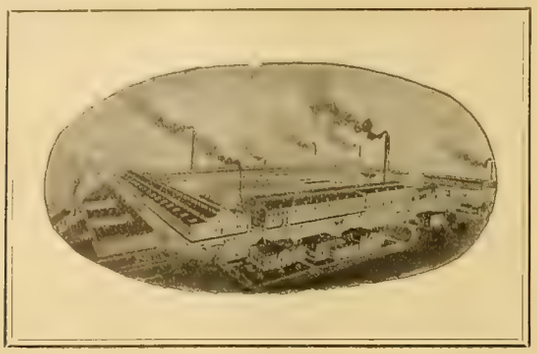

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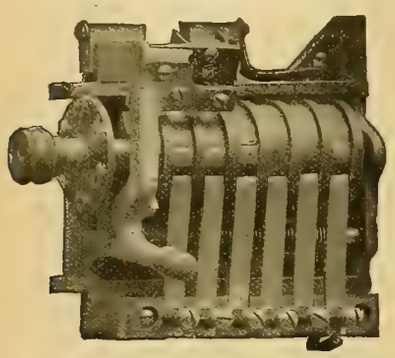

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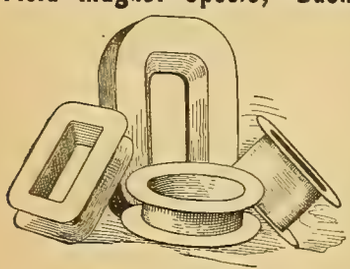

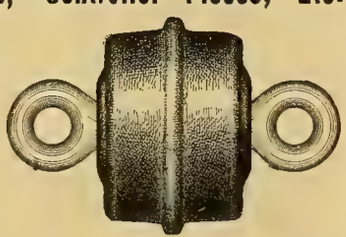

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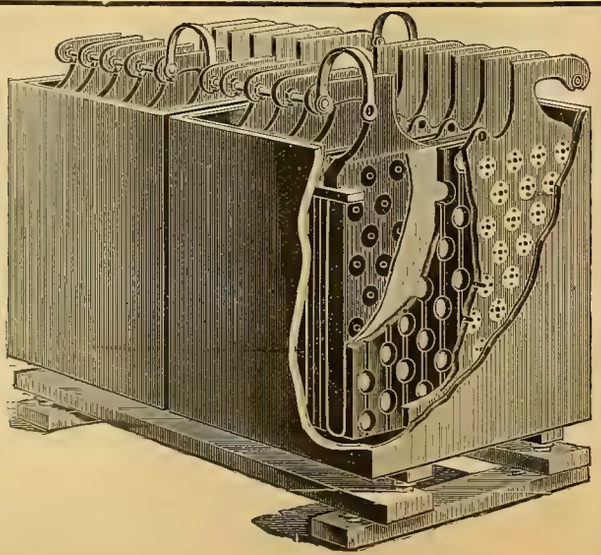

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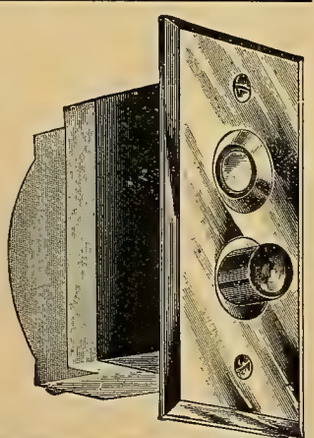

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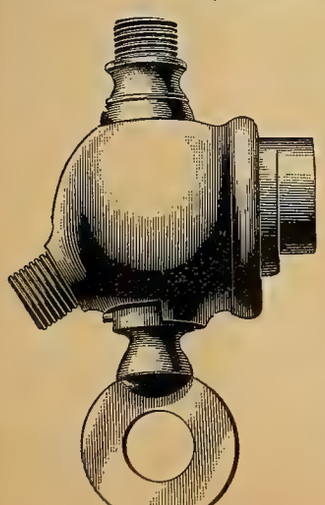

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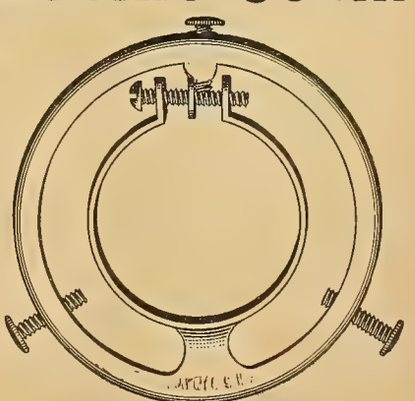

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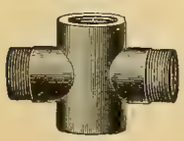

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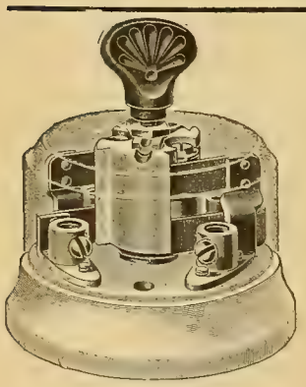

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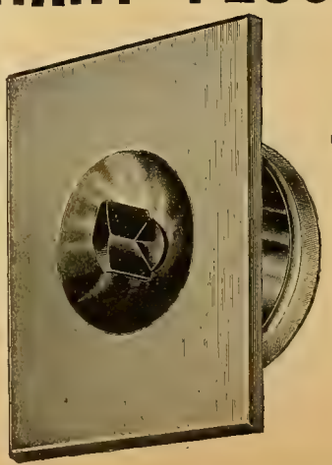

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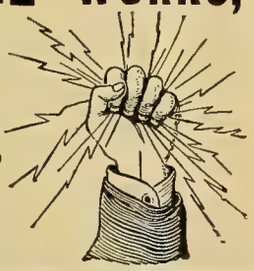

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The points or teats on the lower rim of the petticoat attracts the water on the outer surface of the insulator into drops. The water drops from these points on to the cross-arm, thereby preventing the moisture from creeping up on the inner petticoat, and thence to the pin. Owing to the great success of our Patent Teat Insulator in Telegraph Work, where the efficiency of the Insulator has proven to be more than twice that of the ordinary Insulator, we have concluded to apply the device to all Insulators for Telegraph, Telephone and Street Railway Work.

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For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

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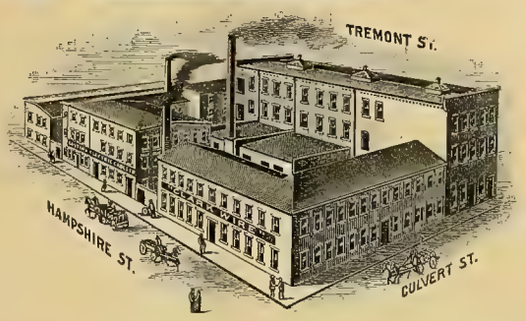

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I find the amount of:

Ammonium Chloride	contained	therein	to be	99.51	per cent.
Ammonium Sulphate	"	"	"	0.03	"
Moisture	"	"	"	0.13	"
Non-Volatile Matter	"	"	"	0.02	"
Organic Matter	"	"	"	0.31	"

The Non-Volatile Matter consists of Iron Oxide and Alumina.

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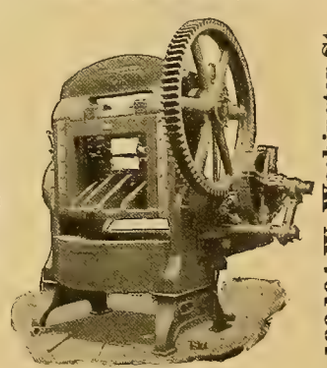

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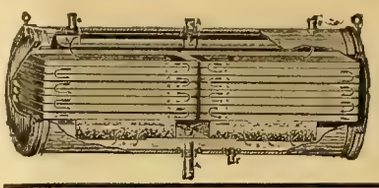

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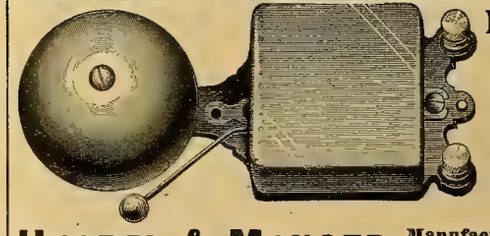

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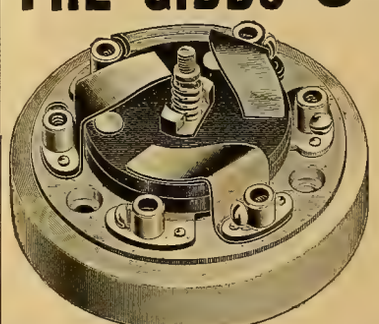

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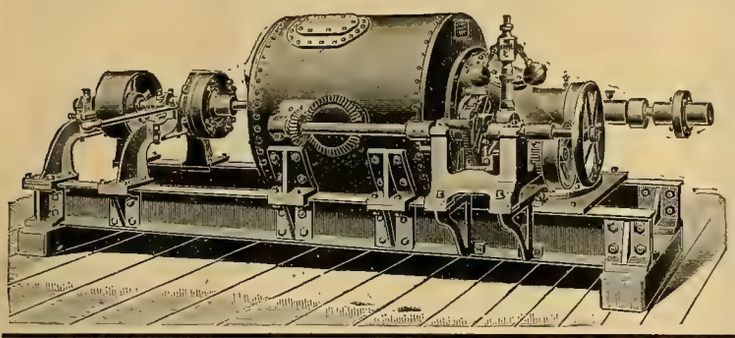

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high speed and great Efficiency,** and **Large Capacity** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect **guaranteed.** **SEND FOR CATALOGUE AND PARTICULARS.**

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Thus spoke our friend Polonius to Claudius and then he started out on his journey .....

.....followed this road.....

.....arrived here in due season and stopped.

The other day, incidentally meeting us in the street, he threw his arms around us and exclaimed: "The friends thou hast and their adoption tried, grapple them to thy soul with hoops of steel."

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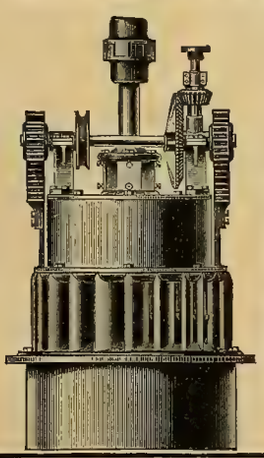

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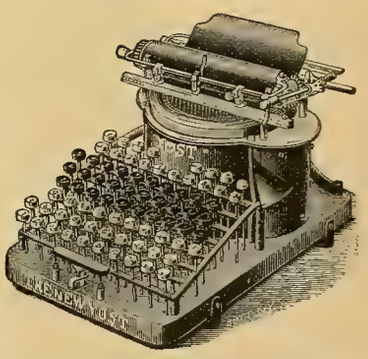

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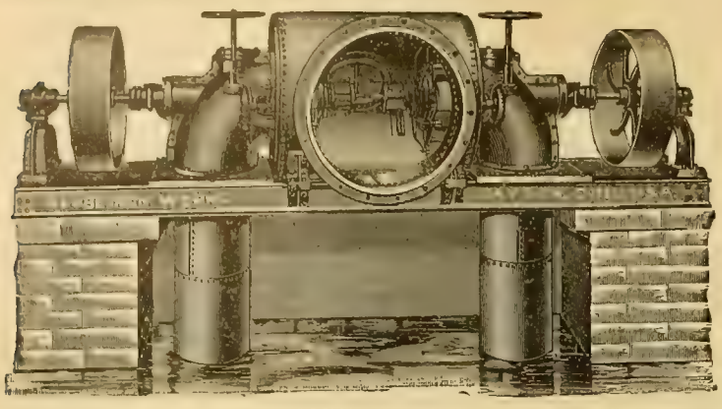

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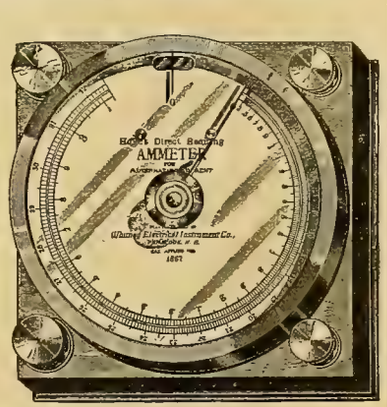

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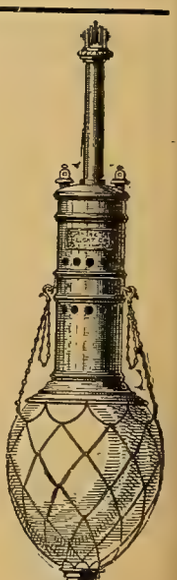

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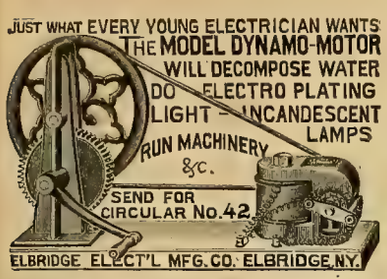

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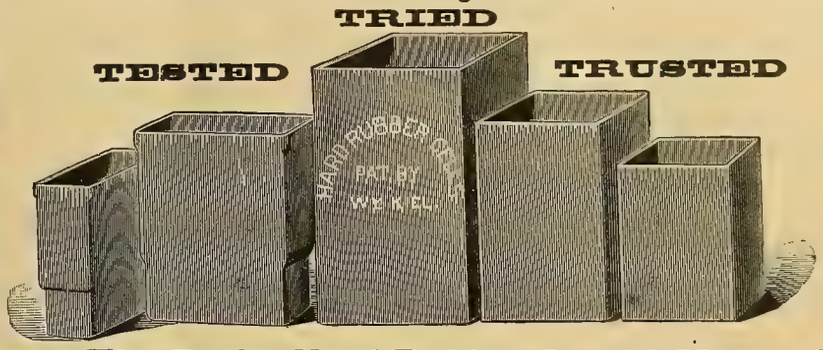

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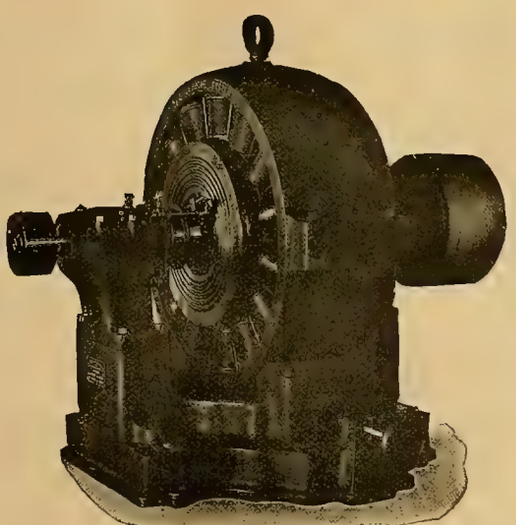

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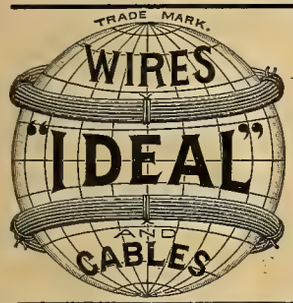

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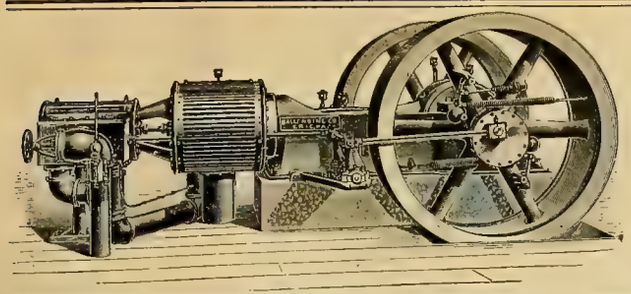

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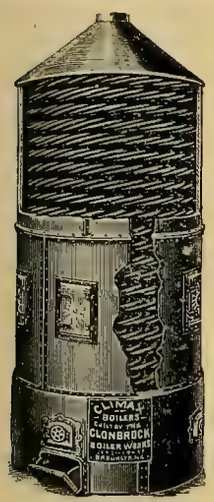

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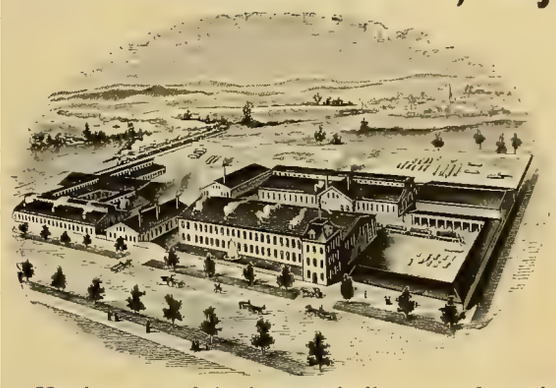

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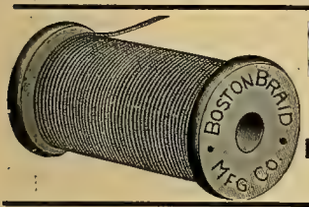

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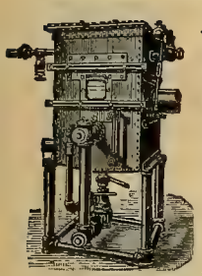

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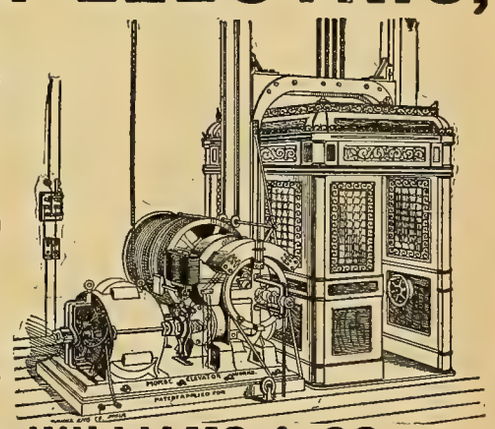

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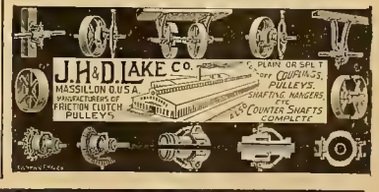

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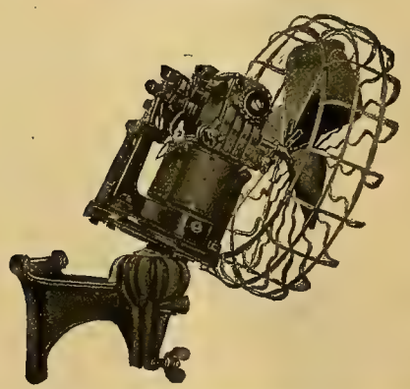

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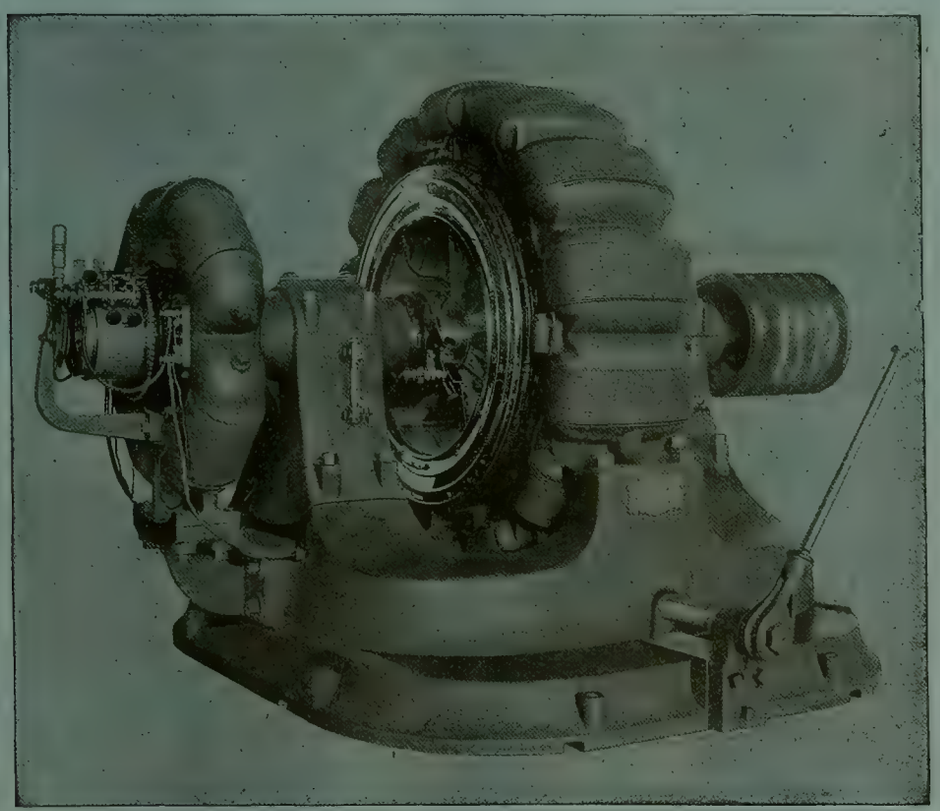

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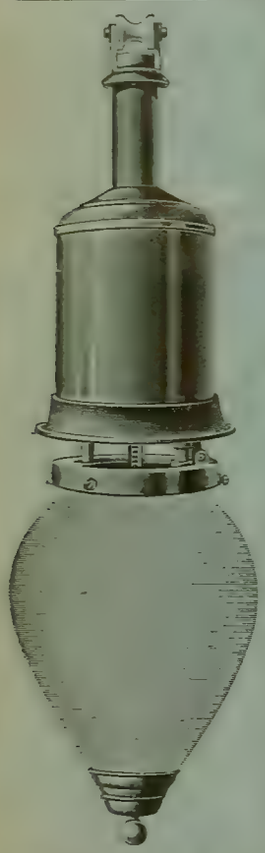

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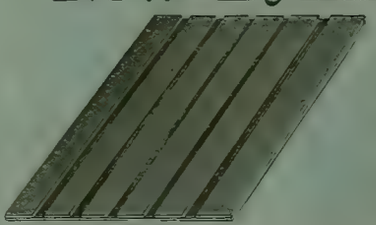

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Monadnock Building, Chicago.

TO FIT ANY STANDARD SOCKET.

Judge Ricks' decision against the Edison Company and in our favor, frees these lamps from any taint of infringement. Order no other.

THE BUCKEYE ELECTRIC CO., Cleveland, O.